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A COMPARISON OF CERTAIN MENTAL AND PHYSYCAL MEASUREMENTS OF SCHOOL CHILDREN AND COLLEGE STUDENTS

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Historical Section

The relation that exists between the physical and the mental status of an individual has interested many investigators in the past. To many people it no longer appears as a problem to be solved, or at the most it appears to be merely one which they are inclined to believe their common sense and general observation will enable them to answer satisfactorily off hand. Nevertheless, it remains a subject as yet unsettled from the standpoint of scientific investigation.

One source of confusion is the great variety of methods and means that have been employed in attacking the problem. Several physical criteria have been used, ranging from crude measurements of height and weight to the use of the height-weight or weight-height index. To determine the mental status the investigators have relied on almost every kind of estimate, from that of school grade to the use of mental test scores and I.Q.s.

Another cause that has lead to difficulty in evaluating the results of previous studies is the variety of combinations used. For example, one person may procure the relation between weight and height, taken separately, and school grades, or grade location; another, between the same physical measurements as those mentioned above and a mental age, or even an I.Q.; but in the more recent studies the height-weight index and the score of some standardized mental scale or an I.Q. derived therefrom are employed.

The present day psychological conception of the integration of the nervous system and the coordination of the entire organism would not permit us to regard the development of the body and mind as independent of each other; nevertheless, the views concerning the importance of the relation of one to the other have not always been the same. From the days of the Greeks to the present time there has been a swinging back and forth of the pendulum in regard to the extent of such relationships.

Studies concerned with the physical and mental status or development of the child seem to fall in a general way, into three groups. The earliest are those which deal with physical development. First, the investigators in this field were interested in the general question of the physical growth of the child and were either anthropologists or those identified with educational work. More recently the greater interest has been in the state of health of the child, of which physical growth is merely an index, or in the investigation of the consecutive growth of individuals. The latter work has been done chiefly by members of the medical profession, whose interest naturally lies in the state of health of the child.

The second group consists of those studies which seek to correlate the physical and mental efficiency of the child. Here we find the terms have a variety of meanings. Physical may refer to weight, or to stature, or to the relation of the two; or to physical or anatomical development; or to vital

capacity or motor ability; or to glandular secretion. Mental, on the other hand, may mean the grade or school standing, the estimate of the teacher, school marks, or the scores of intelligence tests, of specific tests or of groups of specific tests.

The third group deals alone with mental development as shown by school promotion and grades or so called intelligence tests, whether a battery of tests or specific tests.

A. Correlation of Physical and Mental Development.

The question of the relation of the physical and mental development of the child is one of initial importance to those whose interest lies chiefly in forwarding the welfare of children. Especially has this been true since Porter in 1893 found a positive correlation between physical development and mental ability, as a result of the measurement of St. Louis school children.

Since that time a numver of studies have been undertaken with one theme:-Are children who are more fully developed physically more capable mentally than those who are less favored?

The conclusions reached are most conflicting, but today there is a growing conviction on the part of teachers, students of education, and workers in educational psychology, as well as on the part of the laity, that there is and must be a close relation between the physical amd mental development of children.

Whether the lack of agreement among the investigators is due to inaccurate observations and unscientific methods of investigation, or to inadequate standards it is difficult to say.

Porter's (87) work terminated with the correlation of the height and weight of 34,500 school children in St. Louis with their age and grade. A positive correlation was obtained between the physical development so measured and mental ability, of which grade standing was taken as a measure.

He says, "Precocious children are heavier and dull children are lighter than the mean child of the same age". In 1895 Boas (19) writes in a review of Porter's investigation, "I should prefer to call the less favorably developed grade of children retarded, not dull, and these terms are not equivalent". He further maintains that, Dr. Porter

has shown that mental and physical growth are correlated or depend upon common causes; not that mental development depends upon physical growth". Dr. Boas points out that Porter's results merely showed that children who are physically more vigorous accomplish a greater amount of mental work and that those predisposed to illness will naturally be retarded in grade standing.

Regardless of such criticism Porter writes in 1896 (86) "The time in which we live will always be memorable as the beginning of a great educational reform. It has seen the complete demonstration of the law that, on the average, the physical strength of the child and his power to do school work go hand in hand". It would seem from the many references to Porter's work that his expression "power to do school work" has been interpreted to mean inherent mental ability n and not as Dr. Boas interpreted it.

In 1894, Gilbert (48) carried on elaborate research work on the physical and mental development of school children He wished to test specific abilities, both physical and mental, and so correlated a group of tests including height, weight, lung capacity, fatigue, voluntary motor ability, muscle sense, sensitiveness to color differences, force of suggestion, discrimination time, reaction time and time memory with mental ability. Altogether, about 100 children of each age group from 6 to 17 were measured.

In order to compare the results of the respective tests with general mental ability he accepted the teacher's estimate of the latter, rather than school grade, which stan-

dard Porter had used. Such rating Bilbert believed would be more accurate than a system of set examinations upon which grade promotion depended. Gilbert's results were negative. He found no correlation whatsoever between physical and mental measurements.

Shortly after this Boas made measurements on Toronto children, which data were worked up by West. At the same time West was making similar measurements on the children of Worcester, Massachusetts. Their method of determining general mental ability was the same as that used by Gilbert. West (109) says: "The teachers were asked to classify their pupils as "good", "average", or "poor". They were to make their estimates not on mere class standing which would be influenced by such irrelevant matters as regularity and punctuality of attendance, but upon the observed natural quickness, general aptitude for assimilation of ideas and initiative.

West reports a negative correlation between physical development and intellectualability. He says, "The 'poor" are the better developed throughout, except in the case of girls of 14 and possibly boys of 13". "On the whole", he continues, "we may from these observations consider it safe to say that precocity bears an inverse ratio to bodily development".

He offers the following reasons for this discrepancy from Porter's results. "Porter grouped his material in two

ways - as to age, and then within age as to grade, and in this way made the school grade of the pupil the criterion of his mental powers. He does not take into account the age at which the child entered the school, nor his regularity of attendance, both of which would serve to determine the child"s grade, irrespective of its ability; instead, he proceeds on the hypothesis that all children enter school at the same age and pursue their studies uninterruptedly thereafter".

West reasons that the method used in Toronto avoided those blunders. However, he admits certain difficulties when he says, "Two facts were noted. (1) The classification would be very greatly influenced by the mental caliber of the teacher making the classification, (2) In all cases it rested almost exclusively upon the markings of the class book. (3) Furthermore, the "poor" students were a mere handful. The teachers were willing to classify the scholars as of "good" intelligence or of "average" intelligence, but "poor" was taken as a personal reflection upon the teacher of the class in question".

Since West admits that in all cases it rested almost exclusively upon the markings of the class book, the evaluation of the mental ability of the children was little better than that of Porter, who took grade standing, which was based on set examination; and it would seem in that case he should have obtained results more like Porter's. Gilbert explained his results by saying he believed the teacher

adjudged as more able those children who gave more time to study and less to exercise than did the others.

The French psychologists, Binet and Vaschide (14), published in 1897 the results of their studies. They considered physical and mental correlations, principally simple and choice reaction time, rate of tapping, dynamometer records, memory, and speed in running. Their correlations were so low they decided that these abilities, are independent although there was a correlation between class standing and physical development. They conclude, "It is not the most vigorous pupils who have the best memory for figures, here considered as an evidence of intellectual development".

In connection with the work of the French authors it is interesting to note the conclusions of other European authorities. Galton found English men of science to be half an inch taller than their fathers. And it is to Galton, also, that is attributed the statement that there is no correlation between grades on academic examinations in college and physical measurements. Woodruff (115) points out that Lombroso in his "Man of Genius" mentions only 26 great men of tall stature whild he names 49 who were short, some of them being even dwarfish or less than 5 feet.

In 1900 Smedley (103) undertook a notable work in the Public Schools of Chicago. He correlated height, sitting height, weight, lung capacity, and ergograph and dynamometer records with age and school standing of 10,123 subjects

ranging in age from 4 to 21 years.

It is to be noted that his procedure was similar to Porter's as were also his results; he obtained a positive correlation. He says, "On compiling results of physical tests it is found that the 12 year old pupils of the higher grades are decidedly superior in height, weight, strength, endurance and vital capacity to those found in the lower grades. This seems to show that one is likely to attain to his highest mental development only as he reaches the physical growth and development which nature has marked out for him". In conclusion, he says, "In general there is a distinct relationship in children between physical condition and intellectual capacity, the latter varying directly as the former".

This statement, "That one is likely to attain to his highest mental development only as he reaches the physical growth and development which nature has marked out for him" leaves room for one to ask, when the other 12 year olds reach a stage of physical development that the more advanced have already reached, will they be equally bright? The time element, i.e., the qestion of rate of growth seems to enter in here, and brings us back to Dr. Boas' suggestion that the apparent correlation between stature and mental ability among school children can be explained as a phenomenon of growth, i.e., variation in maturity only.

Wissler (113) in 1901 published the results of a long series of tests including tests of memory, pitch, color

naming, association, marking A's and reaction time, perception of size, perception of weight, sensitiveness to pain, sensation areas, color vision and color preference, fatigue, rate of movement, accuracy of movement, rhythm and perception of time, along with measurements of height, weight, size of head, strength of hand, eyesight and hearing, many of the measurements having been made under the direction of Cattell upon students of Columbia University, during a period of 7 years. The results are based on records of 250 Freshmen and a small number of Seniors of Columbia College, and also those of a number of young women in Barnard College. He found that physical tests showed a general tendency to correlate with themselves; also that markings of students in college classes correlate with themselves to a considerable degree; but that neither physical tests nor class standings correlate with psychological tests of the laboratory type. The influence of age on mental tests appears to be small. He then arrives at negative results for the correlation of physical development and mental ability.

Wissler thinks this may be due to the physical maturity of college students and that this would account for the decrease of correlation as we approach the college age in contrast to the findings of Porter and Smedley who worked with growing children.

In the same year Bagley (3) reported his study on the correlation of mental and motor ability in school children. His point of departure seems to be from Porter's work.

Porter, after finding a marked tendency toward a direct relation between weight and mental precocity, argued that weight easily stands for motor ability, hence the child increases in mental efficiency directly as he increases in motor ability. But Bagley's study showed results radically different. In his summary he says:

1. There is an inverse relation between mental and motor ability although there are numerous individual exceptions.
2. There is a gradual increase of motor ability with age. The increase in mental ability is not so well marked.
3. Boys slightly surpass girls in motor ability, while the reverse obtains in mental ability.

In 1901, Chamberlain (28) reports some studies carried on in other countries along the line of Porter's St. Louis work. One of these was carried out in Prague, Bohemia, on children from 5 1/2 to 14 years of age. The chief objects was to determine the relation that existed between bodily development and intellectual activity. The conclusions are that a relation between advancement in school from class to class and physical constitution is observable, due to the fact that bodily weakness or sickness keeps the child away from school, frequently causing the loss of a school year, whereas good health allows continuous promotion. This arrest due to sickness apparently influences the sum of the intellectual work performed rather than the capacity for such

work, hence, they believe, one could not argue there was less intellectual capacity as a result of bodily weakness. And finally, they state that although the most capable boys, in the lower classes at least, possess statures above the average, direct evidence of influence of small stature and like physical defects upon intellectual capacity is not forthcoming. This point of view is very similar to that of Boas in his criticism of Porter's conclusions.

In the work of Pearson and Lee (67), 1903, we again meet the coefficient of correlation. They state that inasmuch as there is no sensible correlation between intelligence and absolute size of body, the correlation between intelligence and any ratio of body length must also be small. Their study deals with the correlation of mental and physical characteristics of "honor" men and "pass" men, and they actually found the correlation between weight and intelligence to be 0.0459, while the correlation between intelligence and the ratio of weight to height was 0.0604. The correlation between intelligence and strength of pull was -0.0482, with a probable error of .035 , which shows that little weight can be attached to it. The "honor" men, when compared with the "pass" men were found to be the more intelligent. In conclusion they say, "In no single case, however, is the correlation between intelligence and physical character sufficiently large to enable us to group the honor men as a differentiated physical class or to predict with even a moderate degree of probability intellectual capa city from the physical characters of the individual."

A group of studies by Crampton (34) 1908, Cornell (32) 1908, Rotch (95) 1909, Foster (45) 1910, King (63) 1914, who consider physiological or anatomical age as the basis by which one must determine the physical development and show its influence on scholarship, are of historical importance. In his study based on 4800 records Crampton (36) shows that each chronological age group contains three subgroups based upon physiological age, namely: (1) prepubescent, (2) pubescent, (3) postpubescent. He found that the postpubescents averaged 24 percent to 33 percent heavier than the pubescents of the same age; and that they averaged as much as 11 percent taller. On the dynamometer, the postpubescents averaged about 33 percent stronger than the pubescents. He also found that the higher the grade the fewer were pubescents, age for age; and this showed that the postpubescents were better in scholarship. He says: "Greater height, weight and strength are related to better scholarship because they are all effects of the same cause - early pubescence".

Rotch (95) found that anatomical development proceeded largely in independence of height, weight, and chronological age. He cites the instance of three boys of the third grade, whose chronological ages were seven, eight and nine, respectively. Their place in the school work would indicate, however, that they were about equal, although they differed considerably in chronological age. The Roentgen picture of the carpal bones of the wrist showed them all to be equally old anatomically, indicating that it is the anatomical age rather than the chronological age which corresponds to mental ability".

Foster (45) reports on the educational experiment of "Physiological Age as a Basis for the Classification of Pupils Entering High School", seems to prove that adolescents classified according to physiological age showed a higher percentage of promotion that when the usual grade method was used. He also concludes that a classification according to height would probably produce the same results, since height correlates highly with the advant of puberty.

King (63) publishes in 1914 the results of his study on "Physiological Age and School Standing". He wishes to discover: (1) whether there is any difference in school ability and school progress in the three stages of development, (2) whether maturing at a later chronological age than usual is less favorable to the individual than at an early or median age, (3) whether physiological age has any observable relation to elimination from school. It is the first one of the three questions which is of special interest to us.

He found that the prepubescents of both sexes do better than pubescents, and the pubescents of both sexes do better than the postpubescents. This conclusion is based on the percentage of good grades in each physiological group. All pupils between 10 1/2 and 17 years of age were considered in order to secure immature and mature groups for comparison with maturing groups. As regards the progress through the grades King says, "The figures show clearly that the maturing age in both sexes is favorable to school progress. They are found in the upper classes in decidedly greater numbers than in lower classes".

In that he agrees with Crampton (34) who states: "Progress in physiological age is related to school efficiency". One might easily point out here that progress through the grades; particularly of the larger pupils, is not by any means indicative of the Pupil's actual efficiency, but involves the attitude of the teacher. Often the practice obtains of passing on to a higher grade mature pupils of low mental attainments whereas immature pupils because they are small will be retained in the same grade for another year.

In connection with this group of studies it is of interest to compare a more recent one by Lowell and Woodrow (117) published in 1922. Their data consisted of radiographs of hands and wrists of 402 children, varying in age from 5 1/2 to 11 1/2 years. A record of permanent teeth was also made; and to secure "intelligence" rating, Kuhlmann's 1917 revision of the Binet test was given.

Correlations were made only on the 7 1/2 and 10 1/2 year children, as those were the only groups of sufficient size to permit of it. On the whole their correlations were small. The table is given below.

Correlation between I.Q. and Anatomical Ages.

Age and Sex Groups	7 1/2 yr. Girls	7 1/2 yr. Boys	10 1/2 yr Girls	10 1/2 yr. Boys
r - carpal age with I.Q.	0.23	0.15	0.41	0.30
r - teeth with I.Q.	0.12	0.21		
r - bones and teeth with I.Q.	0.22	0.29		

The correlation between carpal bone development and the numberof permanent teeth for the 7 1/2 year group was surprisingly low, it being only 0.20, P.E.±.09 for girls and for boys -0.03, P.E.±.10. The correlation between carpal bone development and height was low, also, being only 0.14 for girls and 0.27 for boys, showing that one could not be substituted for the other. However, they report that the correlation between intelligence and carpal development was higher than the correlation between intelligence and height.

In conclusion they say, "We will content ourselves with the statement that our data are too limited to settle anything with finality; indications are that anatomical age is not so closely related to intelligence, that our methods of estimating the brightness and dullness of children need to be radically modified". They state, furthermore, that they believe Dr. Crampton (35) exaggerates somewhat when he postulates that "physiological age should be taken as a basis for all records and investigations, pedagogical and social or other treatment with children"; also that their data would not permit them to follow Dr. Rotch when he goes so far as to publish a table showing the proper school grades for each anatomical age as determined by the development of the carpal bones.

A group of studies in which attempts were made to relate the signs of physical and mental defects are those of Binet, Goddard, Doll, Simon and Mead. Binet (12) considered such physical stigmata as malformed hands, ears, head, etc., and

at the conclusion of his study says: "Nothing is more deceptive than the physical appearance of intelligence of a child". He believes they should play only a secondary part in judging the intelligence of a child. Goddard (49), after his extensive work with the feeble-minded, reports that the feeble-minded are consistently shorter, age for age, than are normal boys and that the difference increases with age. The same he says holds true for weight. Girls seem to deviate less from normal than boys in this. He calls special attention to the fact that the morons are almost exactly normal in height until the age of 15 and in weight until the age of 19 when they begin to fall away. Doll (40) confirms the same results. Is it not quite possible that some underlying cause is responsible for both conditions in all grades of mental defectives, as in the case of cretinism?

Mead's (76) study on the relation of general intelligence to certain mental and physical traits is based on data collected and tests made upon about 430 feeble-minded children and 480 normal children. He classified his subjects as regards age and mental ability. In order to classify them for general intelligence he took the grades of the normal children, and for the feeble-minded he used the estimates of those who were in charge of the children. He treated his data under four heads. 1. The age of walking and talking in relation to general intelligence. 2. Height and weight of children in relation to general intelligence. 3. Strength of grip and dextrality in relation to general intelligence. 4. Percep-

tion and memory in relation to general intelligence.

In regard to the relation of height and weight to general intelligence Mead's results are substantially the same as those of previous investigators with the feeble minded. He says:

1. Not only is mental defect reflected on the average in height and weight of children but the more decided the defect the more checked the physical growth.
2. This is more evident in height than in weight, the first being probably less subject to modification by regular habits of sleep, diet, etc.
3. Feeble-minded girls more nearly approximate normal girls in weight than feeble-minded boys approximate normal boys.
4. The commonly known fact that girls are taller and heavier than boys during early adolescence shows itself also with mental defectives.
5. Defective boys and girls are more variable in height than normal boys and girls. Before thirteen years of of age defective boys and girls of institutional life are more constant in weight than normal boys and girls.

Dr. Simon (100) carried on similar studies at a hospital for feeble-minded children in France. He arrives at the general conclusion that a correlation between physical and intellectual development does exist, such parallelism being

only "the expression of the fact that the physical constitution and the mentality of an individual are only two aspects of physiological activity, representing two equivalent forms of the same individuality".

All of these studies point to a definite correlation between physical and mental development. Apparently there is some foundation for obtaining positive correlation in a specially selected group such as the feeble-minded. It would seem that these results have become also to a large extent the basis for the general conception of the relation of mental and physical development in normal as well as feeble-minded children.

Cornell (32) in 1908 took as his subjects, five hundred and fifty-five children of three Philadelphia Public Schools, and secured the following data: (1) the physical record, (2) the scholarship of each, (3) physical defects. This last item divided the children into two groups, the healthy or normal and those with noteworthy physical defects, such as eye, ear, nose and throat defects, dental and orthopedic defects, nervous disorders, mental deficiency and poor nutrition. He reports that the results showed that in each school the healthy or normal children stood higher in their classes than the average child and that the children with physical defects, taken as a class stood lower than the average.

Arnold (2) in his study of "Weight and School Progress" states that "before anything else can be done for the

child he must be properly nourished and fed". He remarks, "A casual glance at the weight of children of the same age in the different grades will convince one that almost automatically, the place of the child in the school is determined by his physique, and that a child will progress more rapidly according to his increase in weight."

After measuring the weights and standing heights of the children of four schools and tabulating them (1) by grade, (2) by sex, (3) by nationality, (4) by school year, he comes to the conclusion that the small bright pupils are small for the grade but large for their age, while the large dull pupils are large for the grade but small for their age; this rule holding in almost all cases. He believes one may safely say that pupils who vary greatly from the average in weight, will usually be found to be undergrade, but that where averages of larger groups are in question the over-weight pupils do not occur in sufficient number to over-balance the number of underweight children.

In 1914 Baldwin (4) made an interesting contribution. His work deals with 43,840 physical measurements made on approximately 1000 boys and 1000 girls, and 21,683 final quarterly term marks of 135 of these same boys and girls from the Horace Mann School of Teachers College, New York City, the University of Chicago Elementary and High School and the Frances W. Parker School of Chicago.

This work is of interest because it is the first attempt to follow constantly the same group of children through the

elementary and high school in physical growth or school standing. Baldwin concludes as regards the relation of physical growth to school standing, "If pedagogical age is to be accepted as a fair equivalent of mental development, tall, heavy boys and girls with good lung capacity are older physiologically[1] and further along in their stages toward mental maturity as evidenced by school progress than the short light boys". He says further, "It follows from the study that rapid healthy growth favors good mental development".

Recently Baldwin (6) has again investigated the relation of mental and physical growth. This time, however, he uses the mental age and the I.Q., as determined by the Stanford Revision of the Binet-Simon tests to determine the mental development. He reports for 49 girls correlations of +0.89 between growth in height and mental age, and +0.71 between growth in weight and mental age, and +0.83 between the exposed area of carpal bones and mental age. The magnitued of the correlation, he reasons, is unduly influenced by the range of the ages of the children which is from 5 to 15 years. The coefficient between height and mental age for the group of 49 girls by the method of partial correlation with age constant is 0.83. That indicates that physically accelerated girls are mentally accelerated.

Wooley and Fisher (16) studied the mental and physical measurements of 753 working children 14 and 15 years of age.

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[1] Baldwin measured physiological age by the appearance of adolescent phenomena.

The following measurements were made:- height-standing and sitting, weight, vital capacity, visual and auditory acuity, grip, steadiness, cancellation, substitution, card sorting, tapping, association, opposites, sentence completion, rate memory, various form board tests and a puzzle box test.

The results of each of the physical ane mental tests were correlated separately with school grade. They repost a positive correlation with school grade for the physical tests as a whole. In the case of the boys, they say, it exists for every test except steadiness, but is less marked among the girls. The girls, on the other hand show no correlation in the tests for strength of hand or in that of rapidity when continued as long as a minute.

All mental tests gave a positive correlation with school grade, that of memory being the largest, followed in order by association by opposites, sentence test, substitution, cancellation, and last of all the puzzle box.

Stewart (105) in 1916 dealt with school marks of 207 boys and correlated physical growth with school standing. He believed there was a positive relation between weight and scholarship in the elementary grades, but concerning the relation in the high school he was somewhat uncertain. His results in regard to the relation of height and school standing were slightly less positive. Moreover, he shows that when individual curves and correlations are considered without reference to the size of the boy, or to his stage of development, it is difficult to see any relation between

physical growth and school standing.

Bickersteth (11) in 1917 correlated physical and mental age of 2500 pupils of elementary and secondary schools. The physical age, he determined by the results of the motor tests, tapping and plunger[1], the mental age by a series of laboratory mental tests such as tests of attention, discrimination, memory, reasoning and analytic and synthetic apperception (spot pattern). The degree of correlation obtained, he believes, gave little support to the conclusion of Porter (87) and Kirkpatrick (65), who in 1900 found a decided correspondence between motor and mental ability, but accords rather with Bagley's (3) results in a similar work.

The work by DeBusk (37) was interesting because he used somewhat the same type of data that is used in my own study. He calculated the weight-height indices of 104 boys and 96 girls. The height-weight index is secured by dividing the weight of an individual by his height. He believed that this index would express the general state of nutrition of the individual. Then as a result of these calculations for his own group and the Smedley and Gilbert groups, he found that

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[1] "The Plunger is an apparatus devised by Dr. McCougall consisting of a heavy brass plate 23 c.c. square, mounted on a wooden base, containing 24 raised sockets 2 cm. high, arranged in a circle 9 mm. in diameter. The test consists in inserting a small steel instrument, monnted in a wooden handle, into each socket in turn as rapidly as possible, the time to make a complete revolution being timed with a stop-watch, and varying from 12 to 30 seconds according to the age and skill of the subject."

the weight-height indices brought out the fact that there was a tendency for the retarded to show the higher indices.

To obtain the mental status, DeBusk used the 1911 revision of the Binet-Simon scale, and used the results as a basis for the classification of subjects into three groups, "accelerated", "normal", and "retarded".

As to height, he found that accelerated boys were taller than the retarded at all ages except 8 and 13. "As a rule", he says, "the retarded groups are both lighter and shorter than the accelerated or normal. Almost without exception when compared with normal or accelerated children of their own age, the retarded show a vital capacity under the average and also a greater variation from the norm than that of either height or weight".

One of the most recent and most important studies, scientifically conducted under controlled conditions, by expert workers, is that of Lincoln, Johnson, and Hunt (60). In summing up the results of the general intelligence tests of the Nutrition and Control Groups[1] they say in part "(1) In tests of general intelligence the undernourished[2] children distribute themselves similarly to children of normal height-weight-age index. The central tendency is slightly higher than that of the Control Group and there are slight differ-

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[1] The "nutrition" group includes the underweight children to whom a suitable lunch was served each school day. The "control" was composed of children who were approximately of average weight for their height and age.

[2] The "undernourished" were those children who were found to be 7% or more underweight, according to the Burk-Boas Height-Weight-Age Tables.

ences in variability. Children of high intelligence scores gain more under the Nutrition Class procedure than those of lower scores. (2) In a learning series the Nutrition Group is superior to the Control Group both in speed and accuracy. (3) In motor coordination and performance tests not involving uninterrupted expenditure of muscular energy, such as Card sorting, Aiming (target test), and Dissected pictures, the undernourished children make normal scores according to established standards and are superior to the Control Group. This certainly would not support the findings of Porter, Arnold, or Cornell. Naccarate and Lewy-Guinburg approached the question of the relation of physical and mental development from a new angle. They considered the relation of hormones and intelligence. This work proceeds on the hypothesis that "the same hormones which promote the morphogenesis of the skeleton, and muscles of the limbs, promote also the development of the psychomotor and psychosensory centers, and would lead to the conclusion that there exists a correlation between the morphological development and the intelligence of the individual".

The morphological index, they say, is obtained by dividing the linear value of the sum of one upper and one lower extremity by the volumetric value of the trunk. As this value corresponds approximately to the ratio, height to weight these investigators used the height-weight index as equivalent to the morphologic index.

The intelligence tests that were used were the army

Alpha for 50 students, mostly females; Otis test for 94 students of both sexes, and Thorndike Examination tests for 252 male college students. The first group gave a correlation 0.44, P.E. ± .06. The second group gave a correlation of 0.15, P.E. ± .07, the third, 0.13, P.E. ± .04.

Dowd (41) reports a study of 110 subjects, fifty-five of whom constituted the "nutrition class" at the hospital clinic. These children had an average age of twelve years. Their average I.Q. was 79 and they averaged 11 1/2% underweight. He compared these with fifty-five who were in the general clinic. They had an average age of 10 years, were 8% underweight and had an average I.Q. of 77. He does not state what measures he used, but that some standards were used for comparison is evident from the above. In his conclusion he says: "In general our experiment has agreed with that of other investigators, that the undernourished children distribute themselves in tests of intellignece similar to normal children". And he further states: "While improvement was shown in all other respects the I.Q. remained substantially the same".

Blanton reports a study of the physical and mantal condition of 6500 children of the Volkeschuler in Trier, Germany. In studying the question of school retardation it was found that the percentage of children failing to pass their grade had increased from 8% in the prewar period to 15% in 1917-18. It was estimated that about one half of the increase was due to malnutrition, the other half to was con-

ditions and the disorganization of the school. Blanton states that 40% of the children were suffering from malnutrition to such a degree as to cause a loss of nervous energy. However, the investigator gives the reader no clue as to how "malnutrition" was determined, other than the fact that the constituents of the war rations and the reduced quality was inadequate for proper nutrition, and the fact that the children were sent up for examination.

To determine the mental condition he seems to have relied chiefly on the report of the teachers and rectors. We are told that two groups suffering from malnutrition in a marked degree were selected fro special examination by a psychological test, but he gives statistical data for only 30 of the 6500 children and apparently no careful systematic testing was done. It is unfortunate that more definite and detailed scientific work was not done, for that field offered rich opportunity for obtaining some valuable facts concerning the effect of malnutrition on mental development.

He draws the following conclusion: "One of the most important things shown in this whole study is how the nervous system of the child of good nervous stock can resist malnutrition to an extreme degree extending over three years. But the feeble-minded, the borderline defectives and those classed as dull are affected and often prematurely so by malnutrition of even moderate severity". Also he states, "The effect of malnutrition on the physical and mental ability of children as shown by this survey depends

on two factors; on the severity of malnutrition and on the mental status of the child".

As a result of the foregoing historical survey one can readily see the evidence is so conflicting that it is difficult to say on which side the truth lies. Those who secured positive results are Porter, Smedley, Bladwin, Arnold, Cornell, Woolley, DeBusk; the group which worked with the feeble-minded; and those who took physiological or anatomical development as a basis for physical development. Of the last group King's (64) support, however, is weak and Lowell and Woodrow's (117) is positively negative.

Those found in the negative camp are Gilbert, Boas and West, Binet and Vaschedi, Wissler, Bagley, Matiegke, Pearson and Lee, Stewart, Beckersteth, and Hunt, Johnson and Linclon.

In collecting their data the investigators classified above have used a variety of physical measurements to determine the physical status, and a variety of measurements of mental ability. Except for the few English studies and the recent works in this country, the investigators, as a rule, did not compute coefficient of correlation.

In spite of the many negative results which have been reported since the work done by Porter there seems to be a persistent and widespread belief that there is a close relation between physical and mental development. Woodrow (118)

says in his book "Brightness and Dullness in Children": "We have already seen that mental ability varies with anatomical age. It is reasonable, therefore, to expect some correlation between mental ability and height and weight. Such correlation is now well confirmed". He then cites the work of Porter and that done on feeble-minded children. He afterwards proceeds to say, "I have already called attention to the fact that children of the professional class are brighter than those of the laboring classes. It is clear that a higher degree of brightness goes hand in hand with better physical development. His own study with negative results appeared later, however.

Pyle, (88) also in his book, "The Mental Examination of School Children", 1913, says, "The correlation between mental and physical development has been established beyond a doubt. It is therefore very important that physical measurements and tests be made along with the mental tests-- It must be remembered, however, that a child's absolute physical measurements are not of much significance unless account is taken of the hereditary stock to which the child belongs". More important, perhaps than the inter-relationship of the mental tests themselves, is their relation to general intelligence, he says, and adds, "A good criterion of general intelligence is the school grade for the year, provided tha grades are determined in a careful manner". The last provision is the doubtful factor, however, as it is practically impossible to eliminate the personal equation of the teacher.

Hall (55) in his "Adolescence" expresses the view that this is a vast but unsolved problem. He refers to Bohannon's work which shows that children who are tall and heavy for their age, are dressed and treated as older children, associate with the more mature and find more is expected of them, all of which treatment tends to force their maturity. On the other hand for those children who are small for their age the reverse is true, which would tend to delay their development. Hall says: "If Porter's inference that large children are intellectually superior to small ones, is confirmed, it may be at least partly due to artificial and not to natural causes, and the popular conception that rapid growth is likely to be attended by sluggish mentality may yet be true to nature.

Professor Leo Burgenstein (25) of Vienna in 1910 wrote, after reviewing the results of investigations in Europe as well as those of American, "We come to the conclusion that inferior physical gifts and development, as well as the existence of physical defects, will, as a rule, be followed by a lower physical condition and therefore by small success in school career, where so much depends on brain work, even if we are not for enough advanced to say with certainty how largely psychical inferiority is accounted for by physical inferiority and how far ill success in education is everywhere due to this cause".

Mental Measurements

Just as a standard of physical growth is needed, so is a measure of mental development desirable. The standards used by the investigators of the studies previously mentioned have been varied; some have used school grades or rating of teacher while others have used some kind of psychological test. It is upon the latter that, at the present time more reliance is placed.

The type of test used by the earlier workers was largely that of the laboratory type, such as reaction time, attention, memory, discrimination, association, and tests of motor skill and strength. A brief description of the tests Gilbert (48) used may serve to recall the nature of the laboratory type of test.

In the weight discrimination or "muscle sense" test, the child was given a box of weights and was instructed to sort out all the weights which seemed to him to be of exactly the same weight as the standard, lifting them endwise between thumb and fingers. The standard weighed 82 grams. "To avoid the effects of fatigue on the sensitiveness to weight, each child was given only two trials on each block, lifting it and the standard alternalely. The successive steps between the weights being two grams, the number of blocks selected as being of the same weight multiplied by two would indicate in grams the threshold for discrimination to weight for that child".

Another test for discrimination that was used was the test to discover the least perceptible difference in the shade of one color. Ten pieces of red cloth, differing in shade were presented to the reactor. A standard, the one containing the lightest shade, was first shown and then the child was directed to pick from a box containing the full set all those shades which were exactly like the standard". "The number of colors picked out would indicate the threshold for discrimination of color for that child".

The aim of the "Force of suggestion" test, Gilbert tells us, was to measure the effect of our ideas of a thing formed by the sense of sight upon those formed by the muscle sense; in particular to get the effect of bulk in a thing upon our judgment of what it should weigh". In this test a set of ten blocks, all of the same weight but varying in bulk, was shown, and the child was asked to arrange them in order according to their respective weights. Gilbert reports, "The decision was universal that the smallest one seemed heaviest and the largest one lightest, the others ranging between those two extremes with weights inversely proportional to their size".

To measure "voluntary motor ability and fatigue", the child was asked to tap as rapidly as he could until told to stop on a button connected with a chronoscope. The child tapped for forty-five seconds. The number of taps made in the first five seconds was taken to represent the voluntary motro ability of the child. The fatigue was measured in percentage by calculating the difference in the rate of

tapping of the first five seconds and last five seconds and then dividing this difference by the number of taps made in the first five seconds.

Gilbert also gave tests of simple reaction time, and reaction with discrimination and choice. In the former the child was asked to press down a key as soon as he saw a movement of a certain disk. The time which elapsed was recorded by the chronoscope. In the latter form of reaction the child was told to react on a certain key if the color, blue appeared when the slide in a box containing two colors, red and blue, was moved. But he was not to react if red appeared; "This compelled him to wait and discriminate between red and blue and also to make the choice whether to react or not".

Still another test used was the "Time-memory". In this test the chronoscope was set in motion and the child was told to listen with regard to how long it was allowed to sound, and then after it was started a second time, he was to stop it when he thought it had gone just as long as it had been allowed to go the first time. "Each child was given ten trials from which the median value was calculated for his general result".

The tests devised and used by Cattell at Columbia differed somewhat from those of Gilbert.

To measure the "strength of hand" the oval dynamometer was employed. The "fatigue" test was made with Cattell's

ergometer.

The test for the "Perception of Pitch" is described as follows: "The test is made with a monochord tuned so that F below middle C is given when the bridge is at 75 cm. The directions for making the test are as follows: "Give tone F twice at an interval of about two seconds to the student whose back is turned. Then shift the bridge to about 50 and let the student find the tone. He must be warned against humming the tune and must probably be taught in advance how to use the monochord. Record the position of the bridge and then give the original tone twice and shift the bridge to the place where it was left by the student in his first trial, telling him that it is put back to this place. Let him now find the tone and record the position. Ask the student whether he plays a musical instrument or sings and record his answers".

In the test to locate "sensation areas" the points of the aesthesiometer, 2 cm. apart, were applied longitudinally to the back of the left hand.

"Sensitiveness to Pain" was determined for the ball of the thumb of both right and left hand by the algometer. He too, had a reaction time experiment.

Rate of Perception was tested by having the student mark out as quickly as possible all the A's on a printed sheet.

"Rate of movement" was tested by having the student put a dot in each of one hundred 1cm. squares, ruled on a blank. "Accuracy of movement" was tested by having the student strike at each of 100 dots arranged in the form of a 10cm. square. He must aim to hit them as nearly as he can and as quickly as possible.

In the "Imagery" test the student was to answer the following question: "Think of your breakfast table as you sat down to it this morning; call up the appearance of the table, the dishes and fool on it, the persons present, etc. Then write answere to the following questions:

1. Are the outlines of the objects distinct and sharp?
2. Are the colors bright and natural?
3. Where does the image seem to be situated? In the head? Before the eyes? At a distance?
4. How dies the size of the image compare with the actual size of the scene?

"Memory" was tested by reading or showing to the student a series of numbers, after which they were reproduced in writing by the student, Logical Memory was tested by reading to him a passage of 100 words and then the student reproduced the thought. The "Association test consisted of a blank containing the following words: house, tree, child, time, art, London, Napoleon, red, enough. This was given the student and he was asked to write after each word as quickly as possible what it suggested to him, preferably a single word.

Many of these tests which have been mentioned have been used ever since, some have been modified and new ones added. Among the later ones those that are frequently met with are the steadiness test, card sorting, tapping (rapidity of movement), sentence completion, association by opposites, omitted letter tests, which are tests both for perception and association; the substitution, which is in reality both a memory and learning test. This type of test has been used extensively in investigations of the learning process, and still another test frequently used is an attention test of various sorts. For a complete account of the general laboratory type of test the reader is referred to Whipple's Manual (112).

Some psychologists, however, saw the use of a different type of mental measurement. Binet, the French psychologist in 1905 was the first person to assemble a set or batteryof tests designated to measure, not any single mental function but the combined intellectual functions, or as it has been termed, "general intelligence". Binet with his collaborator Simon first used his scale in testing the backward children in the Paris schools. It was revised in 1908 and again in 1911 and in the form of this last revision Binet left it to posterity.

As was naturally to be expected this individual type of intelligence test interested particularly the psychologists and those who dealt with atypical children. Consequently we find the members of the latter group, Huey, Goddard and

Kuhlmann, first revising and adapting the scale for use in this country. Later Terman (106) revised and extended it and so made it applicable for educational purposes in general. The scale because of its simplicity has, perhaps, had too promiscuous, if not too general use, and has led to some unfortunate consequences. Town (108) points out this danger and quotes Binet's own warnings, "It is not, in spite of appearances, an automatic method, comparable to a scale which when one stands upon it, throws out a ticket on which one's weight is printed. It is not a mechanical method, and we predict to the busy physician who wishes to apply it in hospitals, that he will meet with disappointments. The results of our examination are of no value if they are separated from all commentary, an interpretation is necessary. We are aware that in stating this necessity we apparently open the door to the arbitrary and deprive our method of all precision, but this is only apparent".

Aside from the vâlue of the tests themselves one additional feature was heralded as being of great value; and that was the method of calculating the results in terms of "mental ages". This very value of marking by age levels has, however, drawbacks as well as advantages.

Terman (106) calls attention to the advance of a measure which any one can understand, for every one has a fairly accurate conception of what is meant when one says a certain person has the intelligence of a thirteen year old child.

The disadvantage of the system is the interpretation which is put upon it. Even though an adult might pass only the test the average thirteen year old child can pass, one can not justly conclude therefrom that the individual knows only what a thirteen year old child knows and would thereby necessarily behave as an adolescent of thirteen.

"Group tests" were next formulated by adapting the material of the Stanford Revision of the Binet Scale to groups of individuals so far as it was possible, and by adding new tests. Otis (82) gives us a complete account of his group tests.

Helpful as the group tests have proved to be, it took the war to bring them to the serious consideration of educators and others who supervised large groups of people.

The revelation that the medical staff of the army was finding large numbers of its male population mentally, as well as physically unfit for service lead to the developing of the Army Alpha and Beta Tests.

In view of the fact that the Army tests were able, after consuming less than one hour's time to roughly place a man in a class where his general intellectual ability might most profitably be used, whereas it formerly took the officers of the training camp approximately six weeks to secure as satisfactory a rating, it was believed the army tests really did test something besides mere learning. Statistically expressed the correlation between army tests and officer's ratings in twelve companies was 0.536, and

in seven of the twelve from 0.64 to 0.75 (120)

This revelation had its rather sudden and spectacular effect upon the schools. Many teachers and school superintendents became much concerned about the mental capacity of their charges and began eagerly and earnestly to seek for some measure of intelligence that could be administered to large groups of children. They did not have to wait long to have their needs supplied, for, forthwith the various group tests appeared, the Otis, the Thurstone, the Miller, the Thorndike, the Anderson, the Brown, the Pressey, the National, the Terman, and the end seems not yet reached.

To go into a complete review of that field is scarcely within the scope of this paper. However, as a testimony of the adequacy of the tests as mental meausres it may be well, perhaps, to mention the results of a few of the many studies in which correlations have been calculated between intelligence tests and class grades or certain educational tests. Jordon (62) shows that the Otis Test when given to high school pupils correlates with all subjects combined 0.450, the Army test 0.476, the Miller test 0.476, the Terman 0.492. Geyer (50) found a correlation of 0.56 between college grades and Brown, and 0.41 between grades and Thurstone, Dickson and Norton (39) reported a correlation of 0.588 between the Otis Scale score and the rating in school of 1013 pupils graduating from the elementary schools of Oakland, California.

Many similar studies are to be found in the literature with coefficients ranging from 0.91 to 0.35. Madsen (68) believes that the reason his correlations are not higher is due to the inaccuracy of school marks and the shifting standard of marking. In discussing the relation of the tests findings and the standing in academic scholarship, Colvin and McPhail (31) report that at Brown University, "Four times out of five the scholastic honors awarded in college go to "high" men ("high" and "low" refer to ranks on the Psychological tests). The rest of the chances belong to the "medium" men since the "low" man is practically out of the running. He may have about one chance in a hundred of getting one honor but almost without exception those who get more than one honor are "high" men.

For pupils below senior high school grade a number of educational tests have been devised and standardized, and the results of such tests when administered under optimal conditions are much more reliable than teacher's estimates as shown by school marks. An extensive study in which the various achievement scores are correlated with several intelligence scores is that of Gates (46). From Grades III to VIII achievement tests were given in comprehension in reading. rate of reading, arithmetic, spelling, writing, and a composite of general achievement calculated. The intelligence measures used in grades I to VI inclusive were the Stanford Revision of the Binet scale. Dearborn, Haggerty, Holley, Meyers, National, Otis, Pressey, Terman Group and Thorndike,

McCall Reading Test, the suitable forms adapted to the various grades. For grades IV to VIII inclusive, the correlation with the composite achievement with the National Form A, is 0.56, with Form B, 0.66, with a combination of Forms A and B, 0.63, with the Otis advances test 0.63; and these two tests, National and Otis gave higher correlations than any of the other ten tests used.

This is not intended to be an exhaustive study of the correlation of intelligence tests scores and school marks or other measures of scholastic attainment, but it does seek to point out that there have been metrical studies made of the relation of scholastic attainment and the results of the so-called intelligence tests. And as a consequence they may be regarded as measures of mental development, at least tentatively. That the correlations are not higher it is probably not entirely the fault of the tests. It is obvious that faulty methods of school grading and the inadequate system of uniformity in school marks should be considered causative factors in accounting for the discrepancy.

When we cease to keep bright children below the level of their ability in school and refrain from pushing the dull child above grade for any number of varied reasons, and also when we have sufficient consecutive and scientific records of individual mental growth, which will aid in the proper placing in the grade and in the suitable advancement of children we will probably find higher correlations between scores on intelligence tests and scholastic achievement.

Standards of Physical Growth

Standards for estimating physical growth have long been in use, and have interested many classes of people from the artist, who looked only for physical perfection, to the small boy who simply wants to know how big he is.

The scope of the contributions in the field of physical growth has been international. They date from the work of Quetelet, who in 1830 published the results of his first investigation on Belgian children. It is particularly interesting in the light of present day methods to get a glimpse of Quetelet's tecnique. He says, "I contented myself with measuring carefully ten individuals of each age, of the male as well as of the female sex, but choosing them in general of a form which could be regarded as regular. The averages of the different groups gave me the condition of development of man from year to year". The fact that he chose "regular form" shows the influence of the artistic procedure. Whether the subjects were actually of "regular form" is a matter of conjecture. Bowditch (24) thought it might well have led him to a rejection of perfectly healthy and normal individuals, whose dimensions did not correspond to a preconceived idea of the typical man or woman. Quetelet, curiously enough, failed to discover the fact that girls are heavier and taller than boys during the early adolescent period, a fact which has been universally verified by all investigators since his time.

The work of other European investigators is adequately

discussed by Bladwin (7), but is not of especial interest to us in connection with this work.

In this country the first work in this field was that of Bowditch (24), Professor of Psychology in the Harvard Medical School, entitled, "The growth of Children", and published in 1877. Bowditch made measurements on 24,500 children of the following parentage: both Americans, both Irish, one American and one Irish, both German, both or one English, and tabulated his findings.

The most comprehensive studies made in America since then have been made by Peckham (1881) in Milwaukee, Barnes (1892) on Oakland, California, children, Porter (1893) on St. Louis children, Boas (1896) who reports the growth of Toronto children, West (1896) in Worcester, Massachussetts, Smedley (1900) in Chicago, and Wood on 2,000 New York children. All of them used the group method. More recently Porter and Baldwin have pursued the individual method in the measurement of large groups. The most extensive investigation on the feeble-minded is that of Goddard (49), who covered over 10,000 cases.

In all of the literature comparatively little data appears on children from birth to six years, for the reason, of course, that large groups of children are not available for measurement before their entrance into school. Likewise there is little available data on growth after 17 or 18 years of age for the reason that the majority of that age are no longer in school. Life Insurance companies have been

able to supply some norms for the mature ages, although, those norms represent a more or less select group.

Among the facts which the measurements have yielded, the most important on growth have been summed up by Burk (26) as follows: "Until 10 to 12 years there is no material difference between the heights of the sexes. But during these two years, varying with localities, the girls begin to grow faster than the boys, and for the two or three years following are actually taller. During the fourteenth and fifteenth years this rate slackens materially, and although girls grow slowly for two or three years longer they have practically completed their growth in height, generally at the age of 15. The rate of accelerated growth in height in the case of boys begins during the period of 12 to 14 as a rule. Boys are slower in reaching their maximum rate and therefore grow rapidly a longer time. They overtake girls in the 15th year, and by the end of the 16th year or later their period of accelerated growth is over".

McDonald (74) says, "For certain length of time before and after puberty girls are taller and heavier than boys, but at no other time.

As to weight, Burk (26) says, "The development by weight seems to follow the law of development in height. Up to the period of pubertal growth there is no material difference in the absolute average weight of the two sexes. There seem to be one or two fluctuations of weights, periods of activity and of rest, apparently between 6 years and the

pubertal acceleration. The acceleration period in boys begins from 11 to 13 years, and ends usually with the 16th, the years of maximum increase being 14, 15, 16. In the case of girls, the beginning is a year or two earlier than in boys and is ended usually in the 14th or 15th year".

King (63) states that he finds the difference between the mass curve and the individual curve worthy of study. The important fact brought out by such a comparison is the somewhat wide difference among individuals in the time of their coming to the pubertal change. Some boys may mature as early as 13, others at 14, and some as late as 16. With girls it may be from 1 1/2 to 2 years earlier.

Smedley (103) says, "An examination of percentiles will reveal a tendency to extreme range of measurement in the outer percentiles in the pubescent years".

One sees that the interest of the majority of the investigations, and especially the earlier ones centers upon the question of pubertal growth. Describing this period Hall (55) says, "The possibility of variation in the soul is now at its height. It is the age of more rapid variation. Individual differences of all kinds are now suddenly augmented. The range of individual differences and average error in all measurements and psychic tests increases".

Henmon and Livingston (56) in a study of Comparative Variability at Different Ages, published January 1922, discuss the adolescent theory and say that in spite of the importance of the theory, no one appears to have taken the

trouble to present the evidence for it, much less question its correctness. Their study represents "an examination of the comparative variabilities as revealed in some of the most representative studies of mental and physical development". They compute from the data of Burk, Baldwin and Gilbert the comparative variabilities in height, weight and lung capacity and found that the general theory held good with weight and height, but lung capacity showed no evidence of greater variability at adolescence.

In line with the question of variability is the study of Robertson (94) made in 1916. Robertson shows the relative variability of weight and stature of the school child and the influence of environment upon the variabilities of these dimensions. He says in his summary:

1. "The rate of growth in the weight of school children of both sexes increases from the 7th to the 15th year and variability in weight undergoes a parallel increase during this period. There is a decided tendency for maxima of variability to coincide with maxima of yearly increment in weight.

2. The stature of the school child during this period increases at almost uniform rate and the variability of stature is correspondingly uniform.

3. The variability of stature is much less than the variability of weight, from which we may infer that as a criterion of abnormality the measure of stature is more reliable than that of weight, while as a sensitive indicator of the effects of the environmental, physiological and dietetic fluctuations, provided statistical methods of

investigation are employed, the measure of weight is to be preferred to that of stature."
There seems then to be a pretty general agreement that it is useful to divide the period of growth into three periods, a period from birth to puberty, a period during the progress of the pubertal changes, and a period after these changes.

The point at which growth matures and ceases is one which investigators have so far, been unable to determine definitely. The report of the committee of anthroploloy places maturity in height of women at 20, of men at 23; others report a much extended length of time, Baxter even extending it to 35 years in men.

Another measurement of growth, about which more has been heard recently is that which has been called at different times by the various names of sitting height, stem length and trunk length. Much of the literature on the subject regards the terms as equivalents.

Gray (51) states this conception of body length appeared over a century ago when Cuvier in 1800 took the length in a straight line from the vertex or snout of animals to the anus. It is somewhat surprising to find it has been used by meny investigators since his time. On this point reference to specific authors is given by Gray.

It is unfortunate that "trunk length" has had different interpretations, for according to Gray (51) Meckle (1828) in 1828 defined "trunk length" as the bony skeleton without

the appendages, that is minus not only the legs but minus the head and neck yielding only the "central portion" of the body. The same interpretation has been put on it by Kenning, 1881, Godin 1903, Dwight 1908, Piersal 1919. While today, Dreyer, on the other hand means by trunk length the distance between the ischial tuberosities and the top of the head, obtained by a certain position for which he gives directions.

The reasons for taking as the body length the "trunk length" of Dreyer; the stem length as Gray prefers to call it, rather than the stature, gray sums up as follows:

1. It is a measurement permitting comparison between man and other species.
2. The stature is an "impure measure" because of the unknown amount of compression of the intervertebral disks (also emphasized by Von Pirquet, 1916), of the unknown degree of the vascular and tissue turgor, or of the varying fat layer in the scalp and soles, of the variations in the angle of the trocherauteric neck, of the varying curves of the spinal column (also remarked by Von Pirquet 1916) and of unrecognized or unmeasurable pathological (rachitic, malacial) shortenings of the leg bones.
3. It is easier to measure than the old "stammlange" to the first coccygeal vertebra.
4. I would add to these reasons, the frequent clinical procedure of allowing for the height of heels, which vary in thichness more than the clothing on which the subject sits.

West in 1896 said, "Comparing sitting height to total stature, we find that, until about 12 years in the case of girls and about 15 in the case of boys, the total stature increases more rapidly than the sitting height, but after those ages the sitting height increases more rapidly. This means that the greater part of the growth is accomplished in the lower limbs until those ages, while after those ages the greater growth is in the trunk.

"We find further that throughout the whole period of growth, the trunk grows more rapidly in proportion to the stature among girls than among boys. At all times the head and trunk make up more than 50% of the stature. Among boys this varies between 51.75% and 55.3%, among girls between 52.5% and 55.5%, but after 11 years of age the percentage of girls is not less than 52.5% rising at 18 to 53.5%, while boys are at least one percent lower".

In agreement with Dr. West, Hrdlicka (51) 1919, wrote "In children of small age the proportion of the length of the lower limbs to the total height of the body is comparatively small and increases with considerable regularity during the years up to and possibly even beyond the age of puberty. This means that as a child advances in life its limbs are growing in proportion somewhat more rapidly than its body", again, "when I compare my sitting height indices obtained by Dr. West, it appears that the indices with those of West's children were at all ages somewhat smaller or that the lower estremities in these children were at all ages

somewhat longer than they are in our children inthe asylum. These figures make me think that it is possible that it is in the lower extremities where lies the principal defect in the growth of badly nourished children, but I can say nothing positive on this point".

Dreyer (42) seems to think the work of the earlier investigators, who considered stature only as of importance as a measure of growth, may be easily disposed of. He briefly states, "Investigators who have been concerned with the study and estimation of the physical development of the population of this and other countries must undoubtedly have felt how unsatisfactory the results obtained by the use of existing tables dealing with height and weight of the body have proved..

"Extensive statistics have been gathered, but the information derived therefrom has often been contradictory, especially when applied to collections of individuals varying widely in age and bodily development. Most of the existing tables dealing with the size fo the normal human body are based on the theory that definite relations between age, height and weight exist. It has, however, been satisfactorily proven that such relationships do not exist when individuals varying widely in size are examined. On the other hand it has been possible to show that definite relationships between the weight of the body, the length of the trunk and the circumference of the chest do exist, as well as to demonstrate the uniformity of their relationship

to the vital capacity of the lungs". Then he gives the formulae from which the tables are calculated.

He tells us that the Tables are intended to be used for the following purposes:-

1. The determination of what are the normal proportions between the weight, the trunk length and the circumference of the chest.
2. To gain evidence as to underfeeding or malnutrition during different stages of adolescence or adult life, as well as in various classes and occupations of the population.
3. For the study of the different aspects of physical fitness as measured by vital capacity in its relation to weight, trunk length and the circumference of the chest; for the comparison of adolescents with adults; and of males with females; for the comparison of different trades, occupations and classes one with another, referring all to a definite common standard.
4. The application of these various measurements to patients with organic disease, e.g., pulmonary tuberculosis; as well as to persons with functional disorders, e.g., industrial fatigue, the fatigue of aviators, and so on.

As to his own data Dreyer says, "The data forming the basis for the calculation of the present tables in the case of normal, healthy men and women are derived from the analysis of a number of observations sufficient to ensure a degree of accuracy that should prove entirely satisfactory",

and he thinks that any changes which the tables might have to undergo as a result of further accumulation of data would be so small that the validity of the tables would not be impaired. He further says, "No data regarding the height standing are given. It will also be seen that no reference to the age of the individual is made, because, for the range of indices given, it has been found that the question of age is of little or no importance up to an age of about 50 years".

It is unfortunate that Dreyer did not state more specifically the number of cases used in compiling his tables. He reports measurements on 20 individuals in the section of his book devoted to "Examples", 8 females ranging in age from 9 to 21 years and 12 males from 8 to 15 years of age. While in the forepart of the book he gives one illustrative measurement of a female of 10 years, and another of a male 27 years of age.

In addition to the study of rate of growth and the resulting calculation of the various height and weight norms, these investigators also considerd the factors that influence growth. Among the most important which are listed are nationality, environment, social status, climatic or seasonal changes and food.

Bowditch (24) and West (110) early found that American children were better developed than European, and furthermore, that children born in this country of Irish, English or German parentage while not so large as American children

yet are taller than the children of those nationalities born in their native lands. Bowditch, in searching for the causes for the superiority of stature ofAmericans, and those growing up in America, in some cases not even being born here, thought it would not be reasonable to attribute it to the greater average comfort of the inhabitants.

Since our American population is so cosmopolitan it is important that the proper growth standards should be used, so it is obvious that for American children, norms based on American data must be the ones employed.

As to the effect of the social status, Burk's review states that as early as 1829 Villerme concluded that stature is greater and growth sooner completed, all other things being equal, in proportion as the country is richer and the comforts of the inhabitants more general. Quetelet voiced the same opinion. Donaldson from the data in Robert's Anthropometry thinks that the environment has more influence on males than upon females. Key says after comparing the curves of development in America, England and Sweden that, "The weak period of development before puberty is lengthened for the poorer children to their cost". Thus there seems to be great overlapping of environment and social status, for naturally the two are closely related.

Boas (17) wrote in 1912, "A study of the phenomena ofgrowth of various groups of the same population has shown that early development is a concomitant of economic well-being and that a characteristic of the poor is the general retard-

ation in early childhood and the later rapid growth. It would follow from this that there is a corresponding although not equal retardation in early mental development and a crowding of developmental processes later on, that probably place a considerable burden on the body and mind of the poor, which the well fed and cared for do not bear. The general laws of growth show also that a retardation kept up for an unduly long period can not be made up in the short period of rapid growth and development of the individual".

Robertson (94) reports in 1916, "Among children of 8 years of age it is found that increasing unfavorability of environment and lack of medical care results in a parallel increase in deficiency of weight and stature, accompanied by a decrease in the variability of weight and an increase in the variability of stature".

Seasonal growth was studied by Malling-Hansen (69), who measured the height of 70 boys daily for 2 years and their weight for 3 years. He said that the weight of a 9 to 15 year old boy has three periods of growth during the year. The maximal period from August to the middle of December, the middle from December to the end of April, and the minimum from the end of April to the end of July. During the maximal period the rate of increase in weight is three times as great as in the middle period and almost the whole weight gained in the middle period was lost in the minimum. The growth in height was almost reversed, for the maximal growth period extended from the end of

March to August, the minimum from August to the middle of November and the middle from the end of November to the end of March.

Porter (85) reported the results of his study on "The Seasonal Variation in the Growth of Boston School Children in 1920", a report on 1,226 boys weighed in monthly intervals for 10 years. His results indicate the greatest gain during the period June to December, is about three times as great as the gain during the balance of the year which includes the late winter and spring months.

Holt (58) also studied the seasonal growth. His observations on 1243 boys of 10 to 16 years of age show they increase in weight 1 1/2 pounds more in the six months from May to November than from November to May, and that the gain in height was 0.38 more during May to November. The reason for more rapid growth during the summer months is because this period is spent chiefly in outdoor life, and greater freedom from illness, Holt believes.

The same seasonal fluctuations as those of Porter's findings are confirmed by the New York Association for Improving the Condition of the Poor (81). They report the greatest gains are made during August, September, October, and November, stating that during these four months the boys make 55.3% and the girls 59.8% of the total gains made during the year.

Pedersen (84) in 1922 after a series of weight measurements of children who attended the municipal schools of

Copenhagen, reported results which do not bear out these general conclusions as to seasonal growth. He observes that the summer vacation sojourn has certainly in mose cases influenced the weight of the children. However, it seems to him to be the local conditions, and not the time of year, which affect the weight of the children. McCollum would agree with Pedersen. He claims there is no such thing as seasonal variation, but that the variation in weight depends on what the children are doing.

Even in this empirical field of investigation the survey reveals the disagreement among the workers as to standards of measurement; some believing the full stature should be considered the unit of measure, others, that the trunk length more nearly reveals the stage of maturity. There is rather general agreement as to the years of greater growth, but not as to the seasons.

C. Physical Growth as an Index of Nutrition

During the war attention was frequently directed to the undernourished child in Europe. Then investigations of American children began and resulted in the discovery of malnourished children in our schools, in our slums, in our poor homes, in our rich homes, in our cities and towns and in the rural districts.

Emerson (43) estimates that at least one third of all the children in this country are underweight for their height according to the standards he adopted, and he designates these undernourished children as "undernourished" or "malnourished". He claims that this condition obtains not only with children, but with adults as well, since approximately the same proportion of recruits was found unfit for military service in the late war because of conditions, largely due, according to Emerson, directly or indirectly to "malnutrition". This condition Emerson claims, was not generally known to be a serious matter until the World War focused our attention upon physical unfitness.

The vast amount of literature dealing with this subject within the past few years, reveals the extent to which the medical profession are interesting themselves in this vital question, and who with the help of the scientists and social workers are doing a great deal of work in the attempt to correct the "malnutrition" of children both in the school room and in the clinics.

One may ask then what constitutes this condition called "malnutrition"? It has been defined as a low condition of health and body substance, measurable not only by weight. height, and robustness, but by many other signs and symptoms. What the many other signs and symptoms are naturally interests one. Clinically it is the color of the mucous membrane, the general tonus of the musculature or the presence or absence of subcutaneous fat, that the physician looks for in addition to the physical measurements of height and weight.

Cornell (33) in, "Health and Medical Inspection of the School Child" states that good nutrition shades insensibly into fair nutrition and fair nutrition into poor, and that therefore the personal equation figures in every examiner's results, so that if he is compelled to group all his cases into good and poor his results may be at striking variance with those of others examining the same children. This, he believes is the explanation of the discrepancy found between the reports of medical inspectors and experienced social workers on the one hand, and special inspectors without experience on the other, the former having become accustomed to slum conditions are attracted only by the worst cases, the others going unnoticed, while the latter are impressed at any evidence of deviation and so class those of a low general standard as below standard, basing their judgement on comparisons with well fed American children.

What objective and practical means are then available for determining the nutritional status of a child? Dr. Holt

(59) indicates three standards of nutrition which are "susceptible of application" to large groups of children. The first one is the weight-to-height relationship, the second, the annual rate of increase in weight and growth in height, and third, the general appearance of the child.

It is the first of these standards which is in most general use at the present time by the physicians who are examining or directing the examination of large groups of children. Benedict and Talbot (9) point out that the comparison of height to weight has long been accepted as a comparatively good index of the state of nutrition of adults. And, moreover, that "with adults, no one would thing of considering the relationship between weight and age orr height and age as of any particular significanee, but singularly with children these two ratios, particularly weight to age have long held attention of the physiologists to the exclusion of almost every other method of eomparison".

The chief objection to the weight-age standard, as has been indicated by practically all of the workders in the nutritional field, is that this relationship does not take into account the very important factor of skeletal growth. Another objection is that there is great variation in weight for any given age. In regard to this Holt says, "The weight to age variations are so wide as to make the relationship of very little value when taken alone. The normal[1] variation in

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1. Holt uses normal variation to discribe the range of weights found for healthy children at given ages.

the weight of healthy children of the same race is from 10 to 15 pounds between the sixth and tenth year, while from the tenth to sixteenth year the range is from 20 to 40 pounds. In a private school in New York for boys who come from the wealthiest homes the weight range from the 12th to 16th year was from 40 to 50 pounds, all weights being taken without clothes and by the same physician.

Such evidence shows the inadequacy of such a standard for determining the status of an individual. By far the greatest number of observations that have been published on weight have, however, considered weight in relation to age. All of the earlier studies, such as those of Boditch, Porter, West, Boas, Peckham, Barnes, MacDonald, Smedley, and Baldwin, followed this procedure.

The height-age relation as a nutritional standard is likewise unsatisfactory for the reason that it too shows variation. Holt (58) believes they are still less significant, because height is more influenced by race and family inheritance than weight is. Moreover, height, as Retan (90) says is only a measure of the development of stature; age measures only the time of growth, and their relationship would measure the rate of development in stature, which has nothing to do with nutrition.

From the time of the earliest down to that of the most recent workers in this field it has been observed that the impulse to grow in the young is so great that even when food is insufficient children continue to increase in height at

the expense of the general welfare of the body, often becoming listless just because all of their energy has been consumed in growth and they have none in reserve to be expended in exercise. As aguide then to nutrition height-age norms would be unreliable.

Emerson (43), 1922, tells us that after long experimentation with unsatisfactory standards such as the weight for age and the height for age, the basis of weight for standing height has proved to be an accurate measure of the conditions of undernourished children, and that in the many thousand cases that have come under his observation he has never found an instance in which it has proved to be impracticable. He says, "It may be stated as a physiological principle that a body of a certain height requires a certain weight to sustain it and the most significant test of a child's physical condition is the relation between weight and height". This is apparently a matter of clinical judgment only, and is not based on any actual statistical comparison of measurements of height-weight with measurements of physiological efficiency or objectively determinable grades of health. It still remeins, in other words, a matter of opinion, albeit, perhaps, expert opinion.

Holt (59) is in perfect agreement with Emerson, for Holt thinks that after the first year the growth of the body in relation to weight is of importance and feels that it has not received the attention in the past that it deserves. In a discussion of the various standards for growth and nutrition

in 1918 he wrote, "The relation of height to weight is the only one which is really importmt as indicating the state of nutrition. This ratio expresses the general solidity or robustness of the body and is therefore significant".

Holt thinks that there is only one other guide which is preferable to the foregoing, and that is the annual rate of increase in weight and height. He estimates the annual increase in weight is from 4 to 6 pounds from the 6th to the 10th year, while it rises to an average of 13 pounds in the 15th year. He finds that girls gain at the same rate as boys up to the age of 10 years, but surpass them for the next 3 years. He states then that the annual increase in height v varies normally less than weight, the average increase being from 1 3/4 to 2 inches a year from the 6th to the 11th year. It reaches its highest point in boys from the 13th to 16th year, when it is usually 2 1/2 to 3 inches a year. In girls it is highest from the 10th to the 11th year.

Unfortunately at the present time there are few consecutive records over a long period of growth available. When they do become more numerous we will have a fairer method of determining the standards to which a child should should conform and the magnitude of his deviation from that standard.

In connection with the previous discussion on height and weight, it is interesting to note much the same view as that held by Emerson and Holt was expressed earlier by G. S. Hall (55) who says, "Of all single measurements,

height is the most valuable, easily taken, relatively constant and not liable to much fluctuation. Along with weight it is the truest expression of the energy of growth, the best index of health and gives a datum from which by the use of current norms and standards many other data can be approximately inferred". He then refers to the Tables of Height and Weight compiled by Boas and Burk as the best ones available.

Are the Burk-Boas the best norms? And if not, what norms are better? These are the questions which must be disposed of in any adequate discussion.

Gebhardt (47) prefers these to either Wood's or Baldwin's. The reason he gives is that they are based on the largest number of typical American children, being compiled by recognized experts in the field of anthropometry from the measurements of 45,151 boys and 43,298 girls in the cities of Boston, St. Louis, Milwaukee, Toronto and Oakland. He maintains that the source of Wood's norms is not definitely known and that Baldwin's are not suitable because they represent the nude measurements made in private schools and therefore represent a select group which would not be comparable to the public school child.

This objection to Baldwin's norms may be subject to controversy. Baldwin's norms probably do not represent an average of the masses of children, for presumably the children Baldwin measured are in a better physical state, on the whole, than the average public school child, because

they do come from homes which are able to afford a private school education and therefore able to furnish abundant, if not suitable food. That this will hold true in all cases we know is not possible. On the other hand, by adopting the average of the masses as a standard are we not holding before the child as a perfect criterion an imperfect measure? Why should we not use as a standard a measure which those who develop harmoniously, normally and perfectly, do attain, rather than one which includes the 20% to 40% group who are habitually underweight for their height?

Wood's Tables would have a tendency to satisfy those who still believe in the age factor, as does Rich (92) who says, "Nutrition work among children has been based mainly on the standard of undernourishment that concerns the ratio between height and weight. This disregarded age, and any findings are incomplete without it". At the same time they are in accord with the general principle of the pediatricans because they do provide a relative range in the ratio of height and weight within a given age. The Bureau of Education which publishes Wood's Norms for Public School Use sends the following information as the sources of his statistics.

1. The sources of the statistics include:
   - a. Observations upon American school children by Bowditch, Porter, Boas and others.
   - b. Statistics gathered from 10,000 personal observations upon children in the Horace Mann School in New York City collected during the past eighteen years.

c. Statistics of the life insurance companies for the age period of fifteen years and upwards.

d. Statistics of school children in New York State from fourteen to sixteen years who were examined for the issuance of working papers.

The total includes observations upon about 250,000 children of each sex.

2. In many instances, particularly the observations made in the Horace Mann School, the same children were repeatedly examined.

3. The age standard was the nearest birthday.

4. The nearest entire figure was taken, it being necessary toavoid fractions to make the table small enough for practical use.

5. The weights and heights were calculated as means and averages.

6 6. The weights were taken in indoor clothing without shoes.

In a 1921 Report of the New York Association for Improving the Condition of the Poor, Gebhardt also publishes the above sources.

Gebhardt (81) since his work among Italian children in New York City, feels strongly that there is no warrant for assuming that an average height or weight of a large number of children is the "normal" weight for any particular child.

He thinks that the individual should belong to a social, racial and economic group comparable to that from which the averages are drawn, so he suggests there be supplementary norms of smaller but more homogeneous groups. That is what Clark, Sydenstricker and Collins have done in the United States Public Health Report of May 19, 1922, when they present norms for height and weight based on 14,335 native white children in Maryland, Virginia, North and South Carolina.

Since many of the authorities in this field believe that racial stock should be considered in this relation there is room for objection to the Boas-Burk norms on that score. They would then not be applicable to a certain class of our American public school children; for example, the Italians, Japanese and Jews; as the Burk-Boas norms were bases on children of northern European stock or ancestory. The several "race" curves do show considerable difference when they are plotted for weight and height separately, but when the curves of weight to height ratio for the various races are plotted there is great overlapping. This would indicate that such a relationship, if used as an index of nutrition could be regarded as fairly independent of nationality.

The studies of Gray (52) and his co-workers have been among the most interesting ones recently, which have had for their object ideal tables which would furnish a working basis to determine nutritional status. He derived his "Ideal Tables" by the routine examination of 380 well to do and healthy boys, in a country day and boarding school, from 6 to

20 years of age, of American birth, good breeding and careful nurture. These tables show average height for age, chest girth for age, weight for age and weight for chest girth. This shows a tendency to get away from tha average of the masses toward a more optimal status.

There is also a movement towards the establishment of a standard based not upon empirical data but upon formulae. Von Pirquet's formula found much favor in Austria we are told, and was most successful when used as a nutritional index in feeding the Austrian children during the war. Von Pirquet determined his index which he called "pedidisi" by inventing the following formula $\sqrt[3]{\frac{10\ W}{\text{Sit.Ht.}}} = 100$. Since the war Dreyer (42) has presented his tables, also calculated from formulae, which are:-

Males

$$W = 0.38025 \times \sqrt{\lambda}^{\,0.319}; \qquad W = 0.662 \times \sqrt{Ch}^{\,0.365};$$

$$Ch = \frac{\lambda^{1.1442}}{2.00148}; \qquad V.C. = \frac{W^{0.72}}{0.69}; \qquad V.C. = \frac{\lambda^{2.257}}{6.1172}$$

$$V.C. = \frac{Ch^{2.5352}}{1.5595}.$$

Females

$$W = 0.36093 \times \sqrt{\lambda}^{\,0.313}; \qquad W = 0.30213 \times \sqrt{Ch}^{\,0.284};$$

$$Ch = \frac{\lambda^{0.9074}}{0.761833}; \qquad V.C. = \frac{W^{0.72}}{0.79348}; \qquad V.C. = \frac{\lambda^{2.3003}}{8.2714};$$

$$V.C. = \frac{Ch^{2.5352}}{16.4951}.$$

W = weight; Ch = chest circumference; λ= trunk length;
V.C. = Vital capacity.

Dreyer's formulae, as one sees is calculated in an entirely different fashion from Von Pirquet's. He, too, felt that stature only was inadequate for predicting body weight, so he substituted trunk length for stature and made simultaneous use of chest measure. Trunk length, however, is somewhat different from sitting height.

Von Pirquet allowed a variation of 5% above and below so that all under the pelidisi of 95 were rated as undernourished. The sitting height would seem to be a more reliable standard than standing height, since it bars out length of limbs, in which there is extreme variation.

Bardeen (8) found a steady decrease from infancy to about 10 years of age in pelidisi. Experiments with Von Pirquet's formulae in the United States indicates 95 is too high. 1282 San Francisco children's nutritional status was computed and it was found 53% were below 95. Gebhardt (81) calculated the pelidisi of the Worcester, Massachusetts children from Boas data (1900) and he found the average pelidisi to be 92-94 at different ages, and boys regularly had an average pelidisi one or two points higher than girls.

Pedersen (84) advances the view that no formulae which may be used to determine proportion is thereby necessarily useable in determining nutritional status; because, he maintains they are two different things. He, therefore, condemns the method of determining the index by dividing the weight by the height, and also the one derived by dividing the weight by the cube of the height, and sug-

gests instead actual conditions are better obtained by dividing the weight by the square of the height. However, he says, "The nutrition quotient calculated according to whatever formulae, will, without doubt, always be an uncertain measure of comparison".

The problem of finding satisfactory anthropometric standards for nutrition work is constantly becoming urgent. It is in this connection that Dreyer's work is interesting.

After testing his own "Ideal" Tables and those of Dreyer Gray summarizes the results as follows:

1. The "Ideal Tables show the smallest average error, only 4.6%.

2. The Dreyer-Hanson Tables show an accurate only slightly less for children (mean error 4.8%) and for adult men are plainly the best standard available today (error 4.5%)

3. The Dreyer-Hanson range of error is smaller than the error for other standards.

4. The Dreyer-Hanson Tables exhibit the smallest standard deviation of any method.

5. Dreyer's Tables are derived from a formula and therefore represent a law rather than simply empiricism.

He further says, "For practical purposes their (Dreyer and Hanson) book of tables is cordially recommended as the best standards of weight available today."

Gray (54) also tested out the formulae of Von Pirquet, Bornhardt and Dreyer. Of the three he finds Dreyer's most satisfactory. For young children 4 years and 4 months old

and 3 years 2 months old, he found Dreyer's rule was perfect. He concludes, "Dreyer's complete formula is admirably accurate and deserves widespread trial".

In order to determine the nutritional status of a child even after one has decided on a certain norm, one next has to know how to interpret his findings. Dr. Talbot (9) says, "There is quite a variation between height and weight in children to all intents and purposes normal". We know a child may be either above or below the average height or weight and still be perfectly healthy and normal .

Holt, Gray, Emerson and Manny all say that the point to be emphasized is that the normal curve is not a line, but a zone, and a much wider zone than has been appreciated. This zone, however, at the present time must be determined by the variability from the average, as it is the best available criterion we have.

The "normal" width of the zone varies slightly according to the opinion of the several writers. Emerson and Manny would call the "normal zone that which would include children from 7% under, to 20% overweight for height. Below 7% the child is undernourished, over 20% he is obese.

Holt says, "A child's nutrition may be considered below the normal when he is 10% below weight for his height between the 6th and 10th years, or 12% below from the 11th to the 16th year". One might think that the average number of underweight and overweight children are about equal. We notice the fat boy or girl, but let the small under-

nourished child go by unobserved. We are told by Retan (90) that at least 20% are undernourished while only 2% are overnourished.

The causes of "malnutrition" introduce still another phase of the question. "Malnutrition" has been attributed from time to time to some form of bodily defect such as diseased tonsils, carious or crowded teeth, eye strain, adenoids, flat foot, and so made a clinical problem; or else attributed to large families, which in most cases entails a lack of sufficient food; or of late it has been attributed to ignorance, so made an educational problem.

Two studies are of especial interest in this connection. The Chicago study discussed by Cornell (33) and that of Silvester (99) in New Jersey. In discussing the former Cornell considers the factor of poverty first; and he emphasizes the fact that although poverty and malnutrition are associated with the immigrants in our large cities, especially those quarters peopled by southern Europeans of the lower class, it is not a racial but a social matter. And then he differentiates between the causes of malnutrition among the different classes in America. Among the better class he says it is due to rich food, lack of exercise and late hours; among the poor but respectable Americans the chief cause is coffee and fried meat, while among the lowest class of Americans it is most commonly due to neglect and drunkenness.

In studying this factor in the Chicago schools, Dr.

McMillan and Mr. Bodine (33) reported that the 1123 poorly nourished children in Chicago were found mostly in the lower grades:-In the Kindergarten, 15.9%; Grade I, 13.9%; Grade II, 11.2%; Grade III, 9.6%; Grade IV, 9.1%; thus showing a gradual decrease in number as they went up the grades. They next considered mentally defective children and found they showed a much poorer nutrition than the average child. Truants, too were more poorly nourished.

In contrast to these findings are those of Silvester (99). Accepting 7% underweight as the initial stage of malnutrition he found 28% of the children of Montclair, New Jersey, were undernourished; 24% were found in a school composed of Italians and Negros, but 2% were found in a school composed mostly of Americans of the middle and wealthy classes. As to its frequency in the grades, the first 6 grades had 26% while the upper grades had 29%.

Studying its occurance among the subnormal, he found only 12% of the subnormal were malnourished as compared with 28% of the normal. Then working from the other end he found 22% of the subnormals to be more than 10% overweight, while only 11% of the normal group are more than 10% overweight.

Mitchell and Forbes (78) found from their experiments that the difference in mental ability of the undernourished and normal children was not sufficiently great to be of any value. Many other factors they thought might explain it.

Whatever may be the cause of malnutrition it is a matter that has loomed large in the eye of the public of recent years. Manny (70) says: "Nutrition is not merely a matter of food although that source of growth and energy is the central problem. Nutrition serves as an index of the result of the many strains and stresses that come from adenoids, enlarged tonsils, defective eyesight and other effects of native disability and unhygienic living".

From the summary of the literature, it is obvious that the problem of determining the status of health and development of the individual from anthropometric measurement is in a highly unsatisfactory state. In spite of the enthusiasm of those who have constructed the various scales, it is by no means certain whether purely structural measurements, such as height and weight, will ever prove to be satisfactory measures. If such measures should prove feasible, the problem of determining standards would become a serious one. It has been pointed out that statistical averages of a group fairly representative of the group to whom the standards are to be applied, would be inadequate, since the averages are in part determined by the unknown percentage of defectives present. The selection of an "ideal" or "reasonably perfect" group which shall set the standard is as yet an arbitrary matter, and cannot be put on an entirely scientific basis until measures of functional health and capacity capable of statistical treatment are obtained from correlation with the anthropometric measures which it is

hoped to use as "signs" or "indices" of them.

That any single anthropometric standard can be used on a mixed population, in which many racial strains are mingled, without making the range of variation admissible as "normal" so broad that it will actually include the seriously defective of several racial stocks within its limits, seems improbable.

Furthermore, it must be remembered that the classification of those who fail to conform within a certain degree to a standard such as height-weight, as "malnourished" or "undernourished" is as yet an arbitrary use of the term "nourishment" and its derivation and the extension of the term "nourishment" and its derivation and the extension of the term to cover the ordinary connotations does not yet seem validated. Children who are "underweight" may be"undernourished" in the full sense of the term, but as yet they can strictly be said only to be "undernourished" in the sense of the term as defined by the height‸weight standard, unless further examination of these children shows this to be unequivocally the case.

The relation of anatomical development to mental and physical development remains, therefore, a strictly experimental problem, although one of the mose important of problems, and the application of the as yet tentative standards can not be strongly approved except where such application is scrupulously tentative in the clinical field or is purely for experimental purposes. The immediately

important work is the experimental testing of the most plausible standards, their comparison with the best obtainable measures of mental and physiological efficiency, in order to determine how far these standards may be rated.

The Tests and Their Administration

The subjects for this study included 64 freshmen college students, 135 pupils in a private school from the fifth grade up through high school, and 425 public school pupils of the seventh, eight, ninth, and tenth grades of the Junior and Senior high schools.

The age range of this entire group was from nine years and six months to twenty-two years and two months. The younger ages are those of the children of the private school, and the oldest ages are those of several young men, who,because of the war, had been deprived of attending school for several years, but, who had returned to continue their education. There are no public school children under eleven years. The college students range in age from sixteen years and eleven months to twenty-one years. This group then covers the entire adolescent period, including the prepubescent, the pubescent, and the postpubescent group.

The data gathered included the scores on a group of seven Hopkins special tests, scores on group intelligence tests, several forms being used, and the physical measurements of weight standing height and trunk length, vital capacity, chest circumference, and social data as to place of birth of each subject and that of his or her parents.

It is a matter of much regret that a complete set of data for each subject is not available. This is due to two facts; (1) that between the time of securing the data of the group

intelligence tests and the standing-height and weight, and that of giving the Hopkins Tests and the taking of the trunk-length and weight of the public school children, a mid-year promotion took place. This disorganized the classes and left the data somewhat irregular.(2) Some of the children, having teken one test, were absent at the time the other tests or measurements were taken, thus causing the number to vary in some instances, not accounted for by the former cause. That difficulty was not encountered with the private school pupils not with the college students, as all tests and measurements were made at one time.

The Group Intelligence Tests used were of three different kinds. To the college students was given Form B of the Thorndike Test. With the tenth grade or Sophomores in high school the Otis Group Intelligence Test was used, while it was the National Intelligence Test, Form A that was administered to private school and Junior high school pupils.

The group of Hopkins Tests chosen for specific study and measurement were (1) an Attention Test, (2) a Substitution Test, (3) a Memory Test, (4) a second Substitution Test, (5) a second Memory Test, (6) Omitted Letter Test, (7) a second Attention Test.

The Attention Test consists of a printed sheet of rows of digits arranged in four groups of four rows each. At the left of each row of digits was printed a key number. In this case the key numbers were 12, 13, 14, 15. These were repeated in

the same order for each group. The task is for the student to begin at the left of the top row and to draw a vertical line after the digit which completes a total equal to or greater than the key number for that row, and to write above the digits so added the difference between the total and the key number. He continues adding from the vertical line first drawn, drawing lines and writing differences, until the end of the row is reached. A vertical line is drawn after the last digit, and if the total for the last group is less than the key number the the total is written above the group. The same method is pursued in each succeeding row. A period of ten minutes was allowed for this test.

The Substitution Test used is of the symbol-letter type. A sheet of symbols has a key at the top, under each symbol of which there is a capital letter. The pupils are given the instructions to begin at the first line of symbols and to write under each symbol on the page the same letter used in the key. They were further instructed to take the symbols in order from left to right in each line and not to skip any.

One minute and 15 seconds were allowed for this test, at the end of which time the subjects were told to draw a vertical line after the last symbol marked.

The Memory Test consisted of a symbol sheet with the same symbols as that used in the preceding test but with the key at the top cut off. They were to be marked with the same key. Two minutes was allowed for this test.

The second Substitution and Memory Tests consisted of

symbol sheets, differing from those previously used, but the same key letters were retained. This was done for the purpose of seeing if there would arise any interference from the former association.

The Omitted Letter Test is one in which the pupil must cross our in each word the letter which is missing from the letter group at the right of the word. The words are arranged in two columns. Five and one half minutes were given to this test.

The second Attention Test was identical with the first, except that a different number sheet was used. The key numbers were the same and also the time limit of 10 minutes. This type of test was repeated with a view to detecting any fatigue that might be a determining factor.

The Physical Measurements

The weights were taken in indoor clothing, and without shoes except those of the freshmen college students whose weight was taken stripped.

The standing height was taken by the stadiometer, the pupils being without shoes.

The trunk-length was taken in accordance with Dreyer's directions, with the subject sitting on the platform of the stadiometer. He places the backs of the fingers upon the platform on which he sits, and with the fingers pointing backwards and the knees flexed, lifts the lower portion of the body gently backwards until the lowest bony portion of the os sacrum is in contact with the front of the measuring

standard. The back is then straightened until the back of the head comes into contact with the standard. The head is tilted neither up nor down and the eyes look straight forward.

The circumference of the chest was also secured according to Dreyer's directions which are as follows: "The circumference of the chest should be measured by a tape measure in direct contact with the skin, (or if necessary placed over a very thin garment). The measurement is taken at the nipple-level in males, that is to say at the level of the fourth intercostal space in the nipple line; in the case of the feamles the measure is taken at the same level, just under the breasts. While being measured the subject should stand up with the arms hanging loosely at the sides, and should be encouraged to talk; in this way quite natural breathing is secured, and expansion of the chest beyond the resting position is prevented. The measurement required is that of the normally breathing, not expanded, chest".

The Vital Capacity

To quote again from Dreyer who says: "The term 'vital capacity' is used to indicate the maximum amount of air an individual is able to expel from the lungs by voluntary effort, after taking the deepest possible inspiration. In measuring the vital capacity it is essential to use an apparatus that affords the least possible resistance to expiration, and at the same time gives easy and accurate readings of the amount expired". In this study a wet spirometer was used.

Dreyer's method of measuring the vital capacity was

followed. He says, "The subject should be seated on a high stool, with his back straight, opposite the spirometer". "The subject is asked to fill the lungs to the maximum capacity then the nose is held with one hand, the mouthpiece is placed well inside the lips with the other hand in such a manner as to prevent any escape of air around it. He now blows steadily into the tube and empties the lungs as completely as possible into the spirometer, being encouraged during the last period of expiration to make the utmost effort to expel all air from the lungs". "Five successive observations should be taken and recorded, the subject being allowed time for a short rest after each". "The highest reading out of the five is the one that should be taken as the value of the vital capacity.

The Ages

In computing the ages of the children in this study, if the age included fifteen or more days over the even month, one month was added; if less than 15 days, they were not counted.

The Use of the Data

The Group Intelligence Tests

The scores of the Otis and National group test were converted into mental ages according to the tables and from the mental ages an intelligence quotient was derived. In case the National scores exceeded 136, which score earns a mental age of 15 years and 6 months, they were all treated as earning a mental age of 16 years. This was a rather unsatisfactory method, as there was a great range above that score. With the Thorndike Test and the Hopkins Tests the raw scores were

used.

The Physical Measurements

(A) To determine whether or not the subject was up to the standard set for his age and height the Wood Tables were used, because they take into account both factors. Moreover, they are based on weights with indoor clothing, but without shoes, which correspond to data used here. His age standard is the nearest birthday. The same was used in this study. To get the percentage above or below normal weight for height and age the weight-height indices of Wood's norms were calculated. These indices were found to correspond closely to those secured by the medical officers of the United States Public Health Service in the schools in Frederick County, Maryland, Petersburg and Hampton, Virginia, Charlotte, North Carolina, and Spartansburg and Greenville, South Carolina. Their results are based on the study of the heights and weights of 14,335 children. This was of especial interest because the children of this study are Maryland and West Virginia children, who would have much the same ancestory and environment.

The weight-height index was obtained by dividing the weight in pounds by the height in inches. A low index for a given stature indicates a thin body, a high index indicates the individual is fat or at least of a stocky build.

Next the indices of the subject of this study were compared with the norms and the percentage deviation above or below was computed.

(B) To find if the weight is normal when the trunk-

length is used instead of standing height calculations were made from Dreyer's Tables. He says: "Having ascertained the trunk-length and the chest circumference, find first in Table XIV, (Female). or XIX,(Male), the normal weight corresponding to the observed trunk-length, then look up the weight for the observed chest circumference in Table XIV or XX; add the two weights together and divide by two, and the normal weight for an individual of the observed trunk-length and chest circumference will have been obtained. The weight derived from the Tables is now compared with the actual weight observed, and the percentage deviation above or below the normal is readily calculated. For example:

Female, 10 years of age

Observations: Weight of the body = 74 lbs. 15 oz.
Length of the trunk= 28 5/8 inches
Circumference of chest = 25 1/4 inches

Calculations

Weight derived from length of the trunk (28 5/8 in.)= 75.32 lbs.
(from Table XIX)

Weight derived from circumference of chest (25 1/4 in)=75.17 lb.
(from Table XX)

Averaging $\frac{75.32 + 75.17}{2} = 75.25$ lb. which is the normal weight corresponding to the observed length of the trunk and the circumference of the chest.

Subtracting the calculated from the observed weight,

$74.94 - 75.25 = -0.31$ lbs.

$-0.31 \times 100 \div 75.25 = -0.41\%$

Therefore the person weighs 0.41 percent less than she should weigh according to the Tables".

As all the weights quoted by Dreyer are net weights of body without clothes, we deducted 3 pounds from the weight of the girls clothing. This amount was found to be the weight of the gymnasium clothing worn by the girls of the private schools, and since all the others had standing heights and weight measurement made in the autumn, and trunk-length and weight measurements taken in the spring in a mild climate the 3 pounds was deemed adequate for them, especially in view of the present style of clothing. In 1907 Wood suggests 5 pounds as a suitable deduction for 5 year old children and 6 or 7 for older children, and that a slightly greater allowance should be made for boys than for girl's clothing. So 5 pounds were deducted from the weight of the boys. These minimum deductions were made because weights were taken without shoes, and because the clothing worn was very light.

In securing our data, chest measurements were made only on the college students, as the correct chest measurement is very difficult to obtain. This is a fact which Dreyer recognizes when he states: "It should be noted that the calculated weights derived from chest measurements show greater individual variations than those obtained from trunk lengths. This is more particularly marked in the adult female owing to the difficulty in obtaining successive measurements that are identicalon repeated examination, slight variations of level in

the application of the tape measure to the chest giving rise to considerable variations in the measurements, owing to the interferance of the mammary tissue. The errors thus introduced are, however, small when averaged up by basing the calculations on both trunk-length and chest-measurement, where individual cases are concerned.

If on the other hand, one wishes to compare the weights of a whole group or class of individuals with those of another group or class, little advantage, if any, is gained by averaging the figures obtained from both these measurements. At the present stage of our knowledge it would seem that if greater deviations are found to occur by taking both measurements into account than by basing the calculations on trunk-lengths only, the latter series of observations should be considered the more correct".

Inasmuch as early in the collecting of the data a greater deviation was found to occur when both measurements were taken into account the trunk-length was the only one later taken with the weight.

Vital Capacity and Physical Fitness.

In the Tables dealing with vital capacity in its relation to trunk-length and chest circumference, Dreyer gives three standards, A, B, and C respectively. Class A includes persons living a healthy outdoor life, athletes and persons who compensate for a sedentary life by regular exercise or sport. Class B contains the professional classes, children in the upper schools and others. Class C contains the asti-

sans and elementary school children. In this study all references were made to Class B.

The vital capacity as a measure of physical fitness was obtained in the following manner.

Vital capacity derived from the length of trunk (35 1/2 in.) -
3859 c.c. (from Table XXIII - Class B)

Vital capacity derived from circumference of chest (37 1/2 in.) =
3430 c.c. (from Table XXIV - Class B)

Averaging $3859 + 3430 \div 2 = 4278$ c.c. which is the normal vital capacity for Class B corresponding to the length of trunk and circumference of chest.

Subtracting the calculated from the observed vital capacity

$$4550 - 4278 = +272 \text{ c.c.}$$

$$+272 \times 100 \div 4278 = +6.3\%$$

Therefore, the person shows a tendency to 6% greater vital capacity than he would be expected to have according to the Tables for Class B, calculated from length of trunk and circumference of chest. This measure of physical fitness, too, w was used only on a limited number of college students.

As a result of the procedure described above all physical measurements have been reduced to a percentage deviation above or below the normal weight in its relation to skeletal growth, either that of the complete stature or of the trunk length.

The weight is, however, not considered in the vital capacity, as it introduced greater fluctuations, and "place the too heavy individuals in a class lower than that to which they belong, and the poorly developed individuals in

a better class than their condition merits", according to Dreyer.

However, even when only chest measurements and trunk-length were taken into account, it seems the weight element was not entirely eliminated, for it is the fatty tissue even there which gives unusually large chest measurements, rather than chest cavity.

It is that factor, quite as much as the inaccuracy of obtaining chest measurements, which Dreyer mentions, which makes the percentage of weight deviation less reliable when chest circumference is used with trunk length, rather than trunk length alone.

What constitutes an abnormal weight as far as it is related to physical fitness is a matter upon which there is no definite agreement. Practically all those who have to consider that factor agree that no hard-and-fast line can be drawn between the normal and abnormal. All agree there is a zone within which, if one falls, one may be considered normal, but outside of it, the normalcy is questionable. Dreyer has four categories into which he classifies body weights.
1. Normal 2. *Possibly* abnormal if an individual is found to be as much as 5 percent below or above normal. 3. If he differs from the normal as much as 10 percent he is *probably* abnormal. 4. If he deviates as much as 15 percent he *is certainly* abnormal.

On the other hand the workers in the field of nutrition, persons such as Dr. Emerson, Dr. Manny, and others hold that

7 percent below normal is to be considered abnormal. while a wider range of 20 percent above is the limit set.

In this study the actual percentage plus or minus has been used in the correlation, thus corresponding to Dreyer's scheme.

Where large numbers of score were to be correlated the product-moment correlation was used.

$$r = \frac{\frac{\Sigma XY}{n} - cx.cy}{\sigma x.\sigma y}$$

In dealing with Hopkins Tests where the total group was broken up into smaller groups, the Pearson formula, $r = \frac{\frac{\Sigma XY}{N} - Av.X \cdot Av\,Y}{\sigma X \cdot \sigma Y}$

was the one employed.

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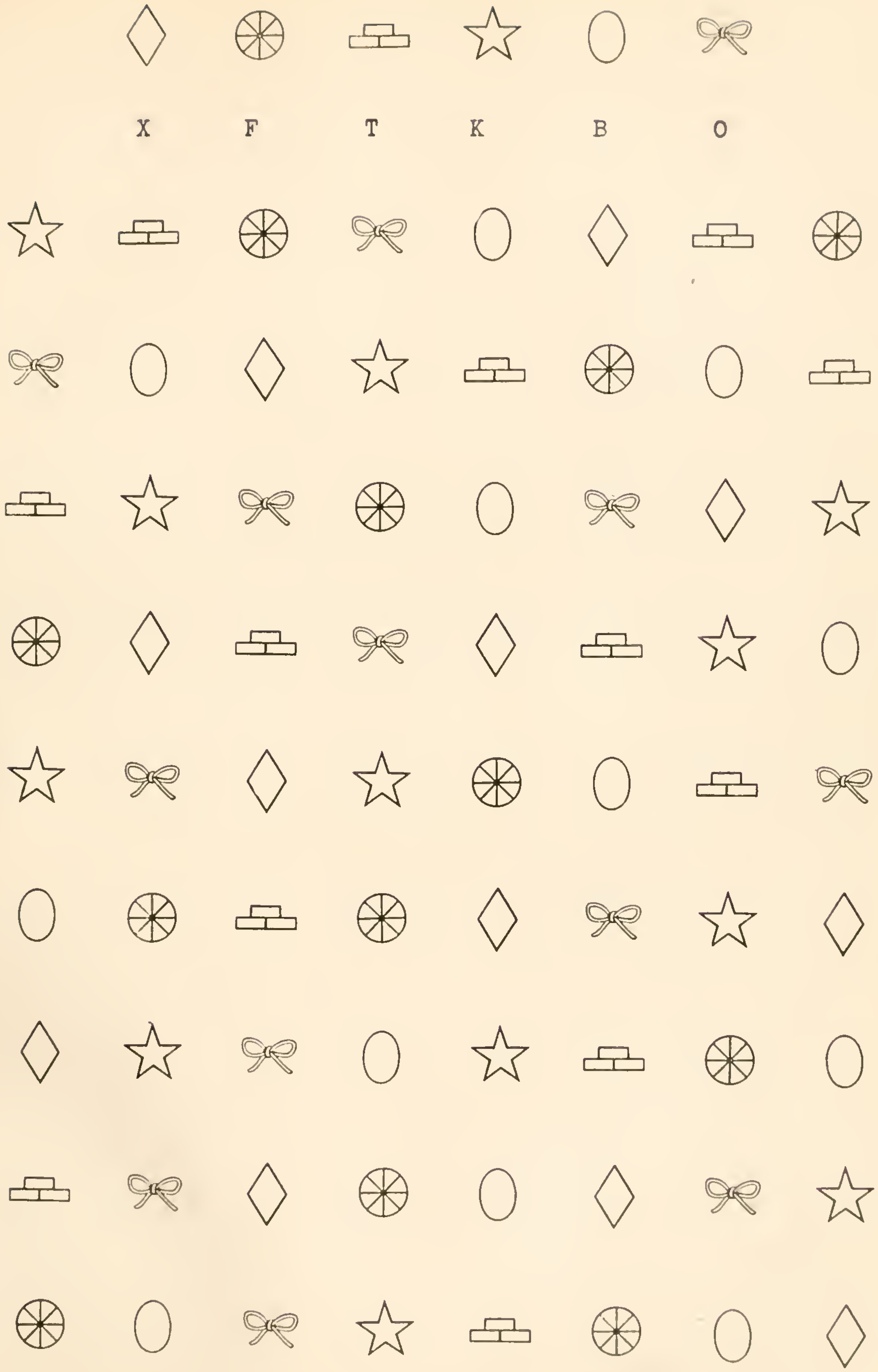
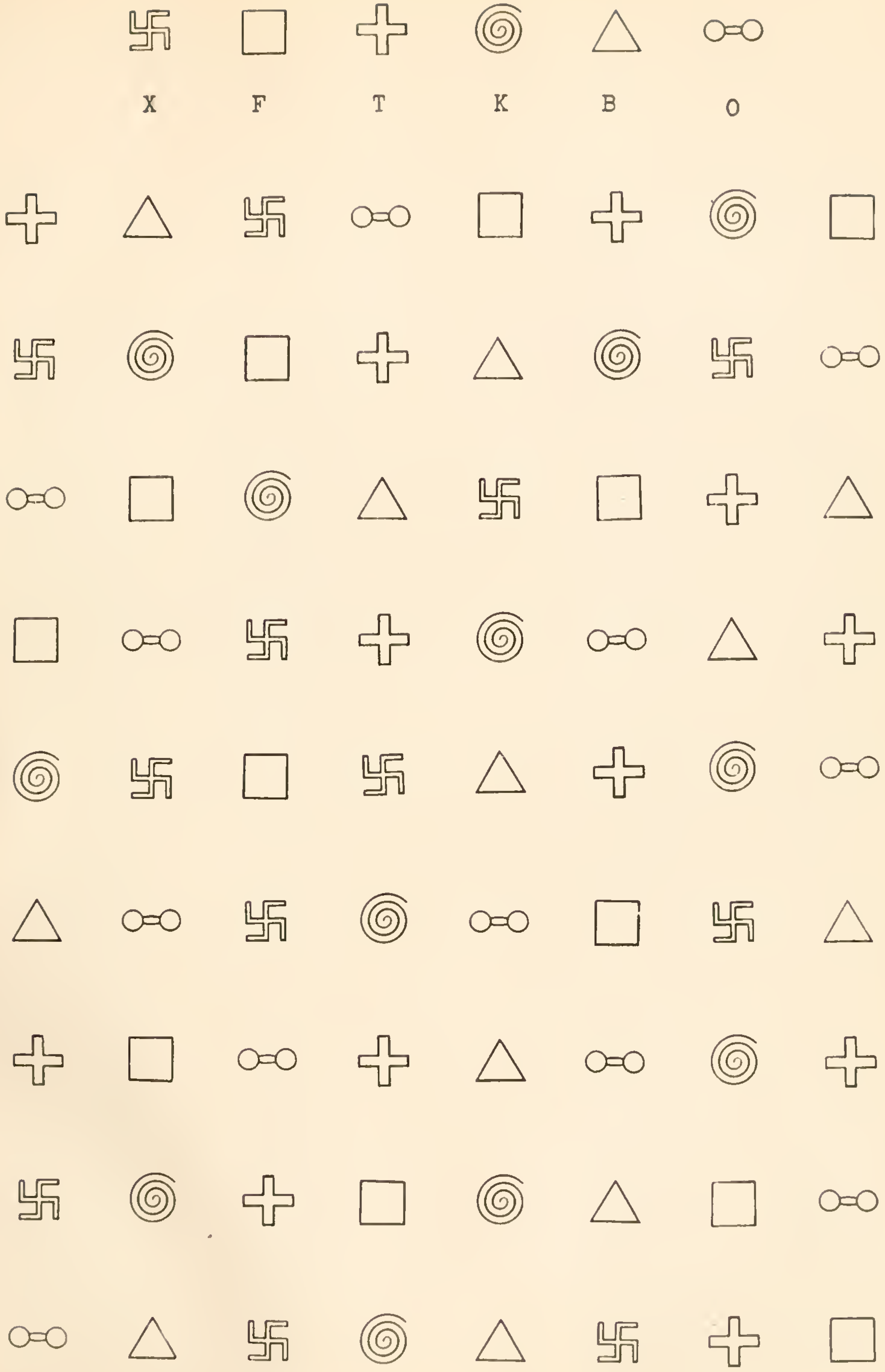


Symbol Sheet (Dunlap) Form 1

Johns Hopkins Series



Symbol Sheet (Dunlap) Form 2

Johns Hopkins Series

POLARIZE	IOERLZP	FLYPAPER	PPLRAYE
MULTIPLY	TPUYILM	GENEROUS	UGOESRN
TEMPORAL	PRLOMAT	INCREASE	SRANEEC
SHRAPNEL	NLPRESA	ASTONISH	SAISHNT
BAROUCHE	CAEURHB	MOURNFUL	UMFOLNU
DYNAMITE	TDAIYMN	PRESTIGE	GPIRETE
REPUBLIC	CBPRULE	DISCOLOR	ROODCLI
EMPHATIC	TMAPIEP	ATHLETIC	CEIALTT
RAVENOUS	NVUREOA	ALARMIST	LTMSARI
TRANQUIL	QAITNRL	JUNCTION	UTNOJCI
SHAMEFUL	EASMFHL	FOREHEAD	FEODHRA
VERTICAL	RAVTCEL	INTRIGUE	IRGNETU
COMPRISE	RMSCPOE	DECANTER	DATERNC
FRIGHTEN	HIEFGTN	POLITICS	PIIOTLC
GOLDFISH	LSGDIOH	DECIMATE	TDIAEMC
DIAGNOSE	ENASGOI	INSCRIBE	ICINERS
INFAMOUS	NSMUIAO	RIGOROUS	SGUROOI
PLEURISY	ESUILYR	AUTOCRAT	TTAAORU
ORGANIZE	GZOAIEN	SEPARATE	PTSAEER
COQUETRY	RCUTOYE	FAMILIAR	IIARLMF
PRECINCT	NRTIEPC	INDECENT	TCDIEEN
DESIGNER	NERGSED	ANTEDATE	TAEANDT
PUGILIST	IITLOSP	BEGRUDGE	BRDEUGG
ULTIMATE	IALEMTT	SURVIVOR	SVVRIRO
PHEASANT	TSENPAA	CRESCENT	TCENCSE
PAMPHLET	ATHMEPL	INCOMING	GMNIOIN
ORNAMENT	NOAERTM	APERTURE	ERRUPET
YOUTHFUL	UUYTOLH	INHERENT	EENTRNI
PLEBEIAN	ILNEAPB	BLESSING	LGENBSI
PROTRUDE	UREODPT	GLOSSARY	LYSORGS
PATHETIC	ETIPHAC	FOOLSCAP	AFLCOPS
ATLANTIC	ATCNLIA	SEEDLING	EGLENDI

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Results

The Correlation of Chronological Age and Weight-Height Index

The correlation between the chronological age and the weight-height index of a group of 497 youths ranging from nine years six months to twenty-one years eight months and with indices fo weight to height ratio ranging from 103 to 2.80 was found to be 0.491, P.E.± .02.

The median age is 14 years and 11 months, the standard deviation being 4.13. The median index is 1.74, with a standard deviation of 5.5.

While the correlation coefficient is sufficiently high to show that the index tends to increase in size with increasing years, nevertheless, it is far from approaching the ideal. On the other hand it is so low that one may be led to the conclusion that only about 50 percent of these children continue to grow in the proper ratio of height to weight, or measure up to the average for their age.

The distribution of this same group for percentage above or below the normal weight shows a range from -27% to +53% with a median of -3%. This shows that there is a tendency to underweight as measured by Wood's Tables.

When the group is separated into the two sexes we find the median of 134 boys is -5%, the range being from -24% to +30%. The median of the 301 girls is -2% and the range is from -27% to +53%. The greatest range is among the girls.

This may be due to the fact that there are more girls measured than there are boys.

Weight in Relation to Trunk Length

A correlation was not attempted between the trunk length and age, as Dreyer states age has been found to be of little or no importance up to an age of about 50 years, and it is, therefore, not included in his norms.

However, distributions have been made of the percentage deviation above or below the normal as computed from Dreyer's Tables for the relation of weight to trunk length, also for the age distribution.

The percentage of range of weight to trunk length ratio of 530 students is from -30% to + 53%. The median is -8%.

Dividing the group into the two sexes we find the 331 girls ranging from -30% to +53% with a median of -8%. The 199 boys have a range from -32% to + 38%, with a median of -8% also.

It is of interest to note that the range is greater for girls in both the distribution of weight in relation to standing height and also in that of trunk length to weight, it being slightly greater in the former. Curiously enough the upper limit is the same and happens to be that of the same girl. This similarity of range may be due to the fact that the two groups measure the same people, but they are not identical groups as some had only standing-height and

and weight measurements while others had only trunk-length and weight.

This distribution also shows a negative tendency- a tendency for this group pf boys and girls to be more underweight than overweight ,as determined by Dreyer,s norms.

This difference between the median when Wood's norms were used (- 3%) and the median when Dreyer's norms were used(-8%) is also worthy of note. This.however ,is no more than is to be expected when we recall that Wood' s norms are based upon averages ,whereas Dreyer' s were calculated from formulae,and more likely approach an ideal standard.

The age distribution of the 530 for whom trunk-length and weight were secured includes ages from 9 years and 6 months to 22 years and 2 months. The median aage is 15 years and 3 months. There were only five children who were below 10 years 7 months of age ,and ten who were 20 years or over.

Distribution Table of Physical Measurements

	Cases	Range %	Median %
Percent Weight above or below the normal	Boys & Girls 495	-27 to + 53	-3
standard of Wood's	Boys 134	-24 to + 30	-5
Tables using weight and standing height index.	Girls 361	-27 to + 53	-2

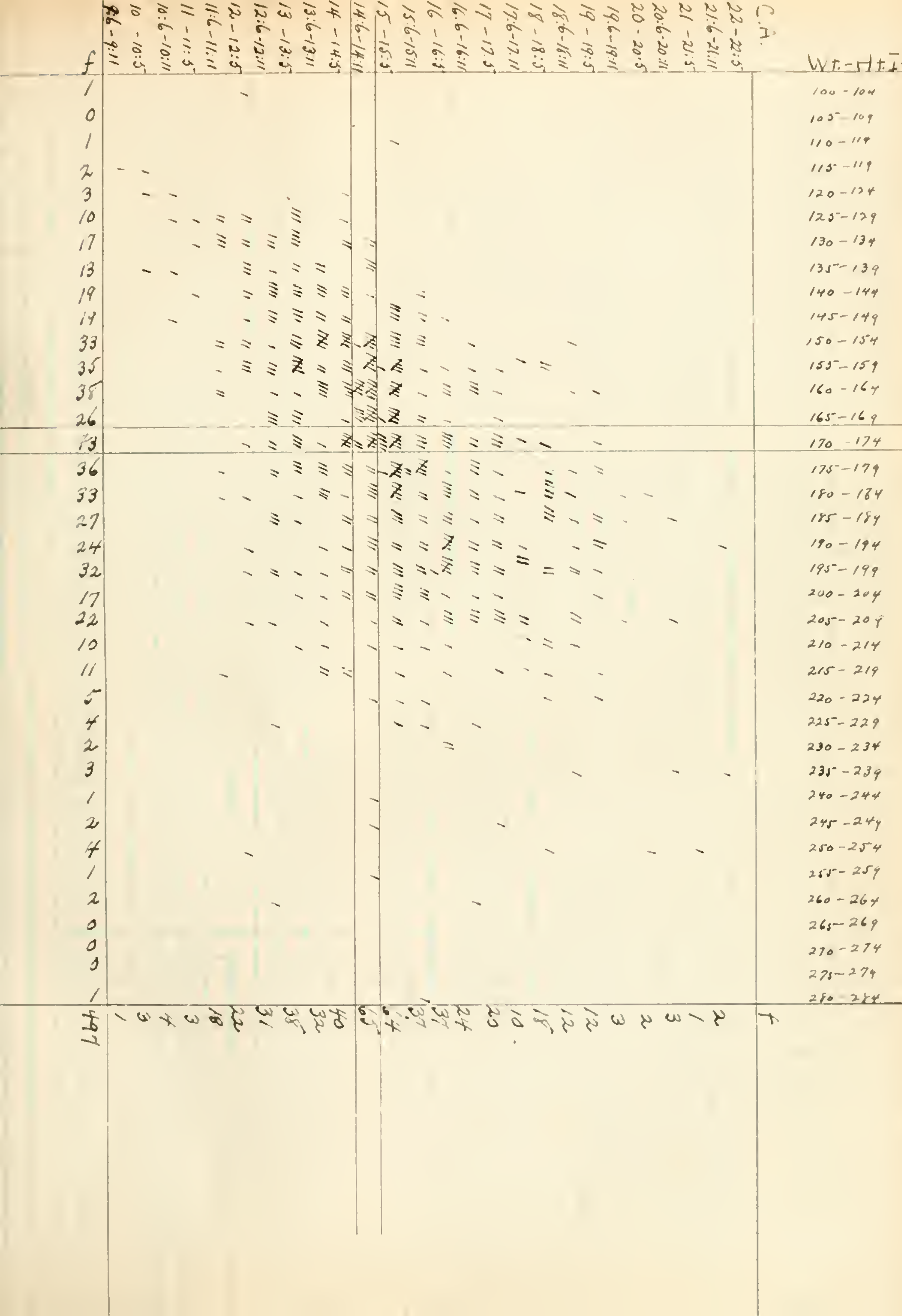
Age range 9 years 6 months to 21 years 8 months

	Cases	Range %	Median %
Percent Weight above or below the normal	Boys & Girls 530	-32 to + 53	-8
standard of Dreyer's	Boys 199	-32 to + 38	-8
Tables using Trunk Length and Weight	Girls 331	-30 to + 53	-8

Age range 9 years 6 months to 22 years 2 months

Correlation Table

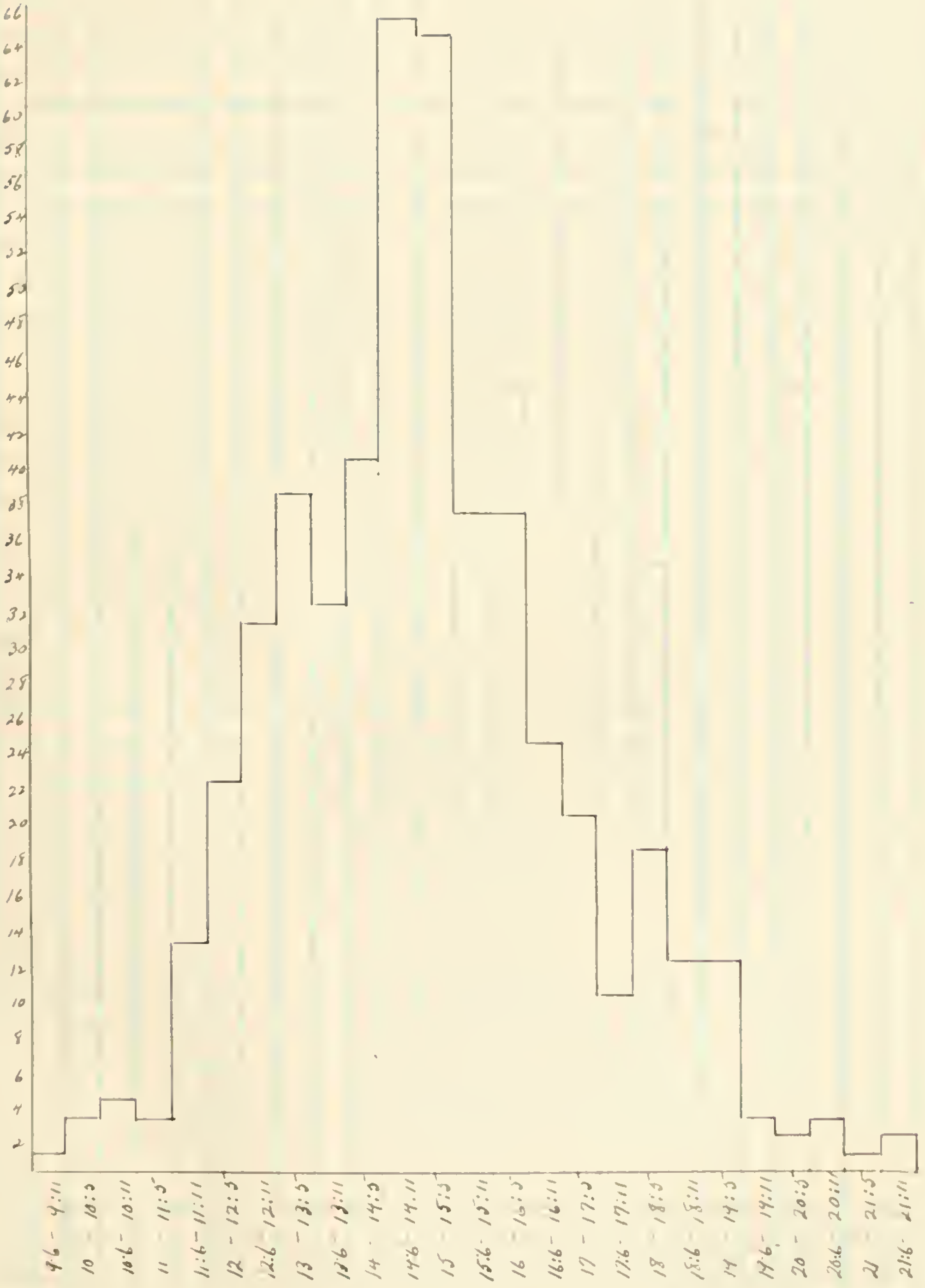
	Cases	Range yrs. mos.	Median yrs. mos.	Average	S.D.	r.
Chron. Age	497	9 6 to 21 8	14 11	15 yrs.	12.78	0.491 ±.02
and						
Wt-Ht Index		1.03 to 2.08	1.74	1.75	27.5	



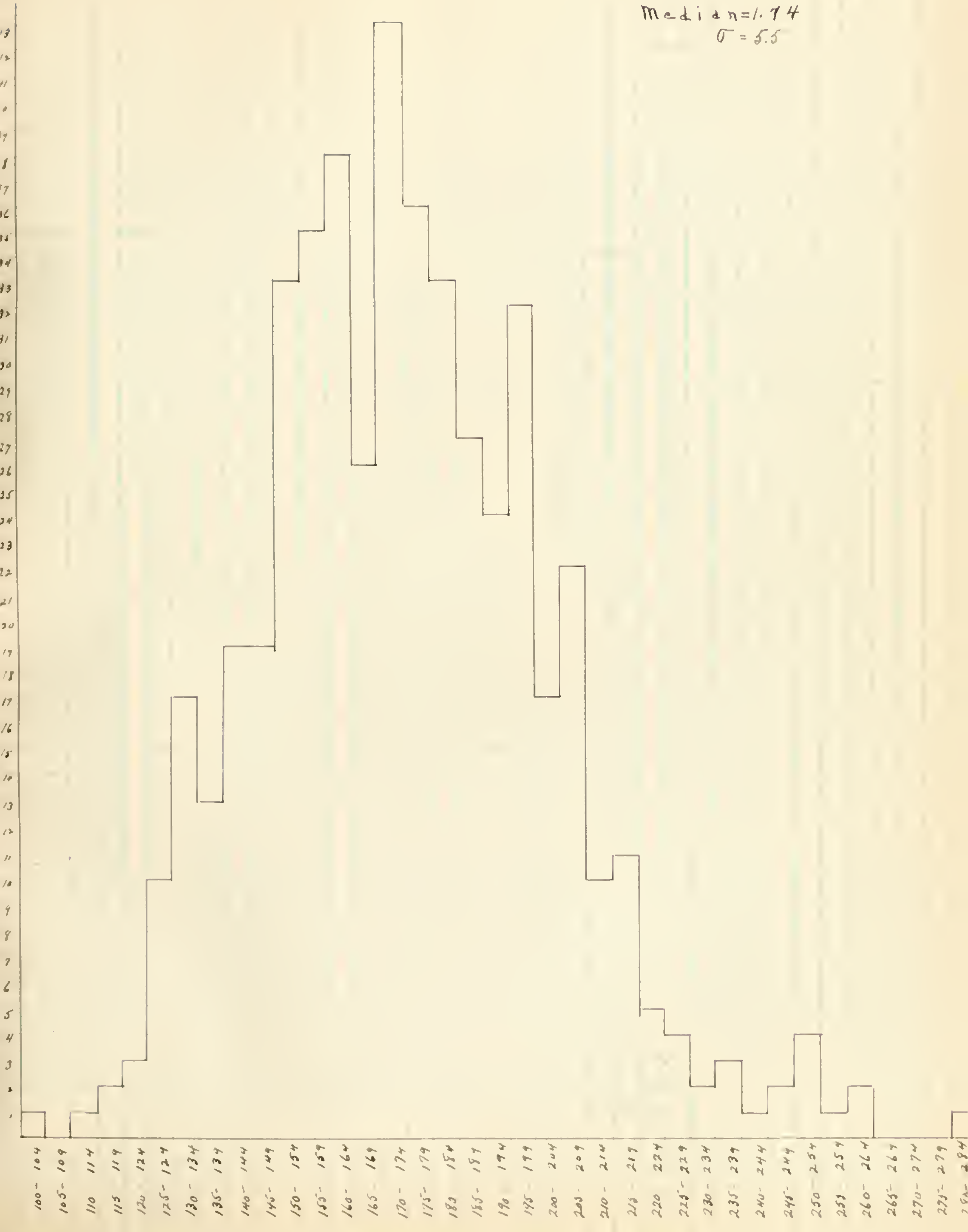
Chronological Age and Weight-Height Index of 497 Students.

Chronological Age Distribution of 497 students

Median - 14 years 11 months
σ - 4.13



Weight-Height Index Distribution of 497 students

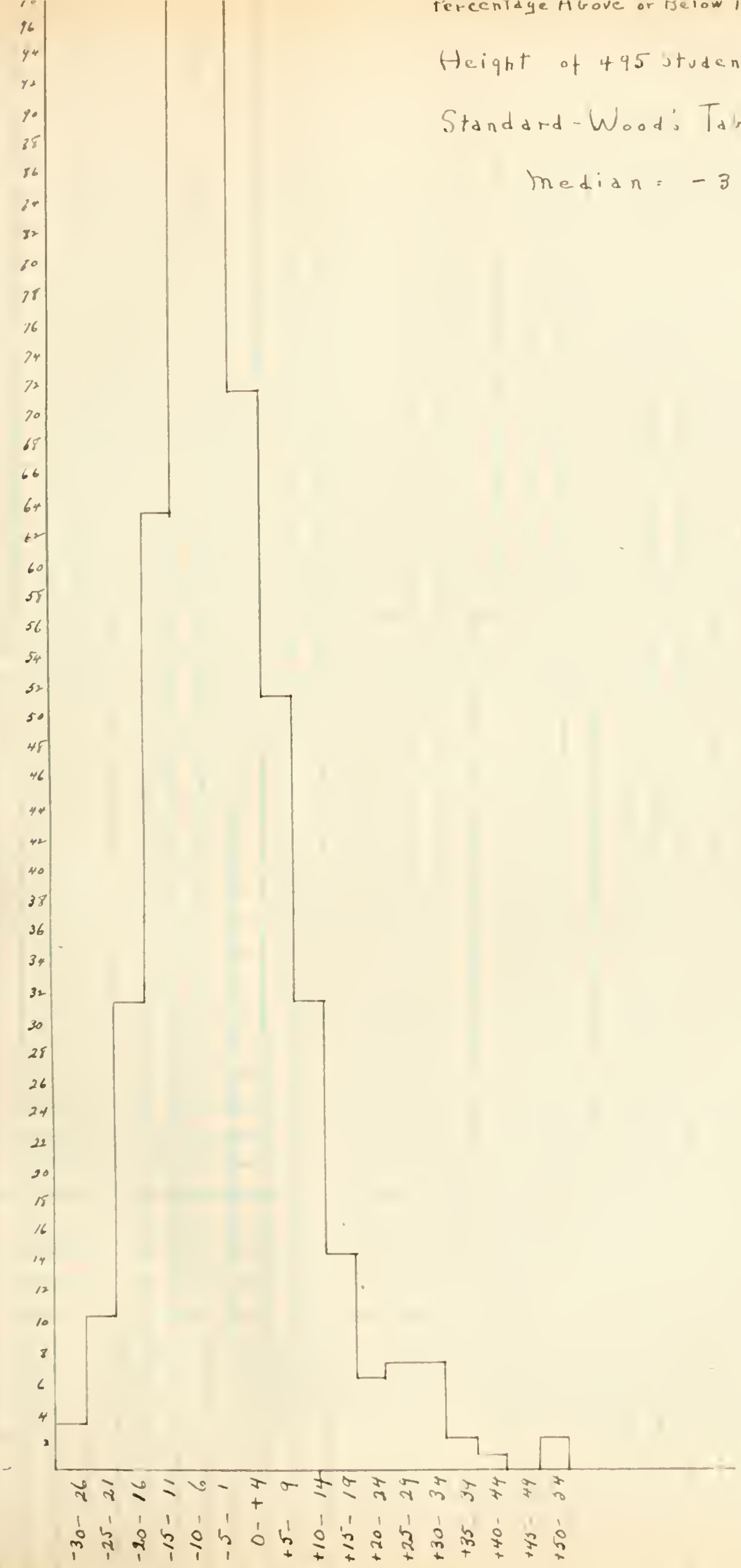


Median=1.74
σ = 5.5

Percentage Above or Below Normal Weight for Age and Height of 495 Students

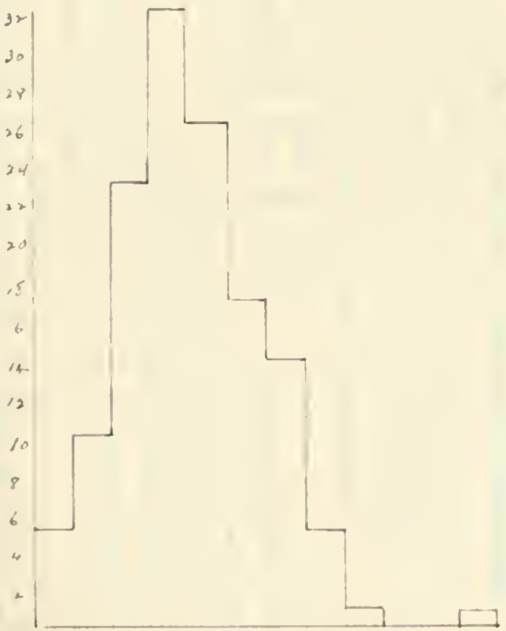
Standard - Wood's Tables.

Median = -3%



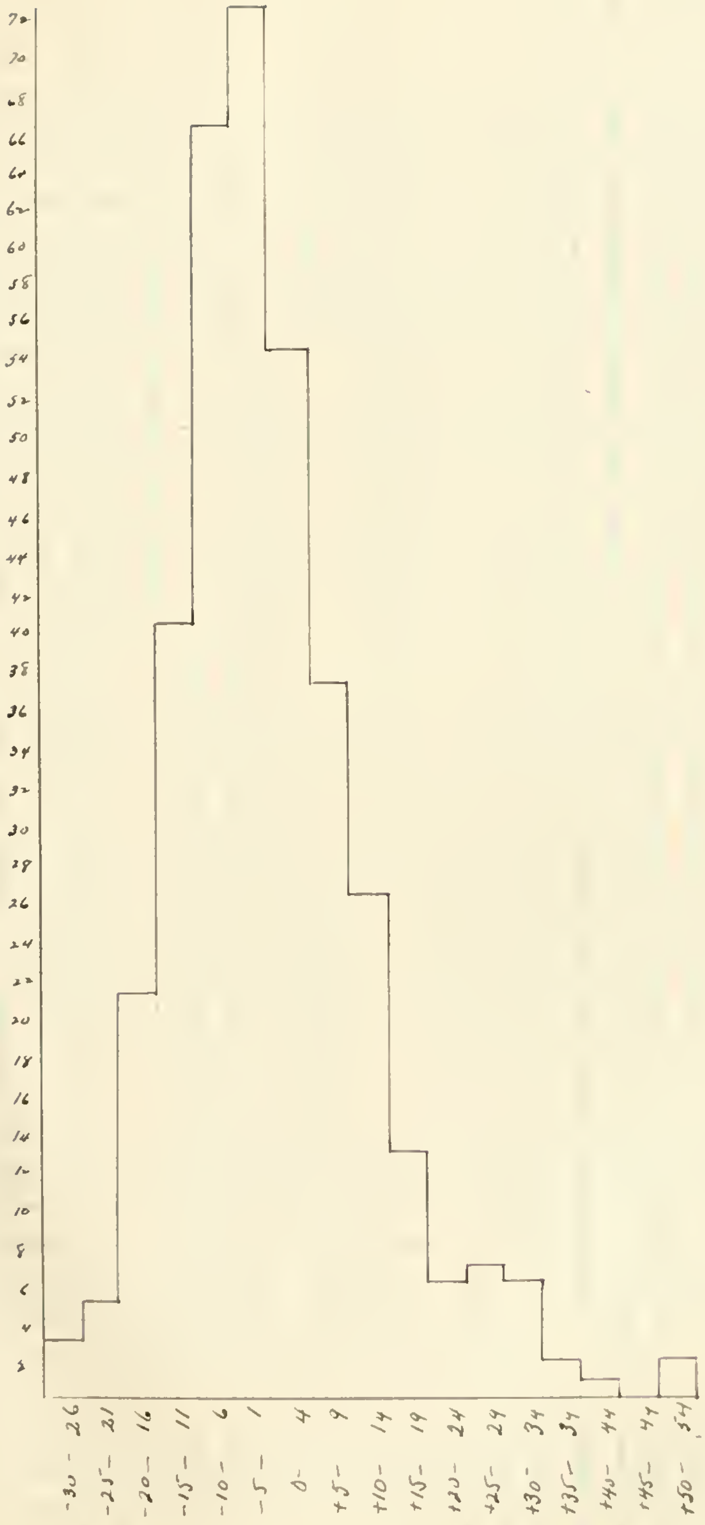
Percent Weight-Standing-height Distribution of 13 yr Boys.

Median = -5%

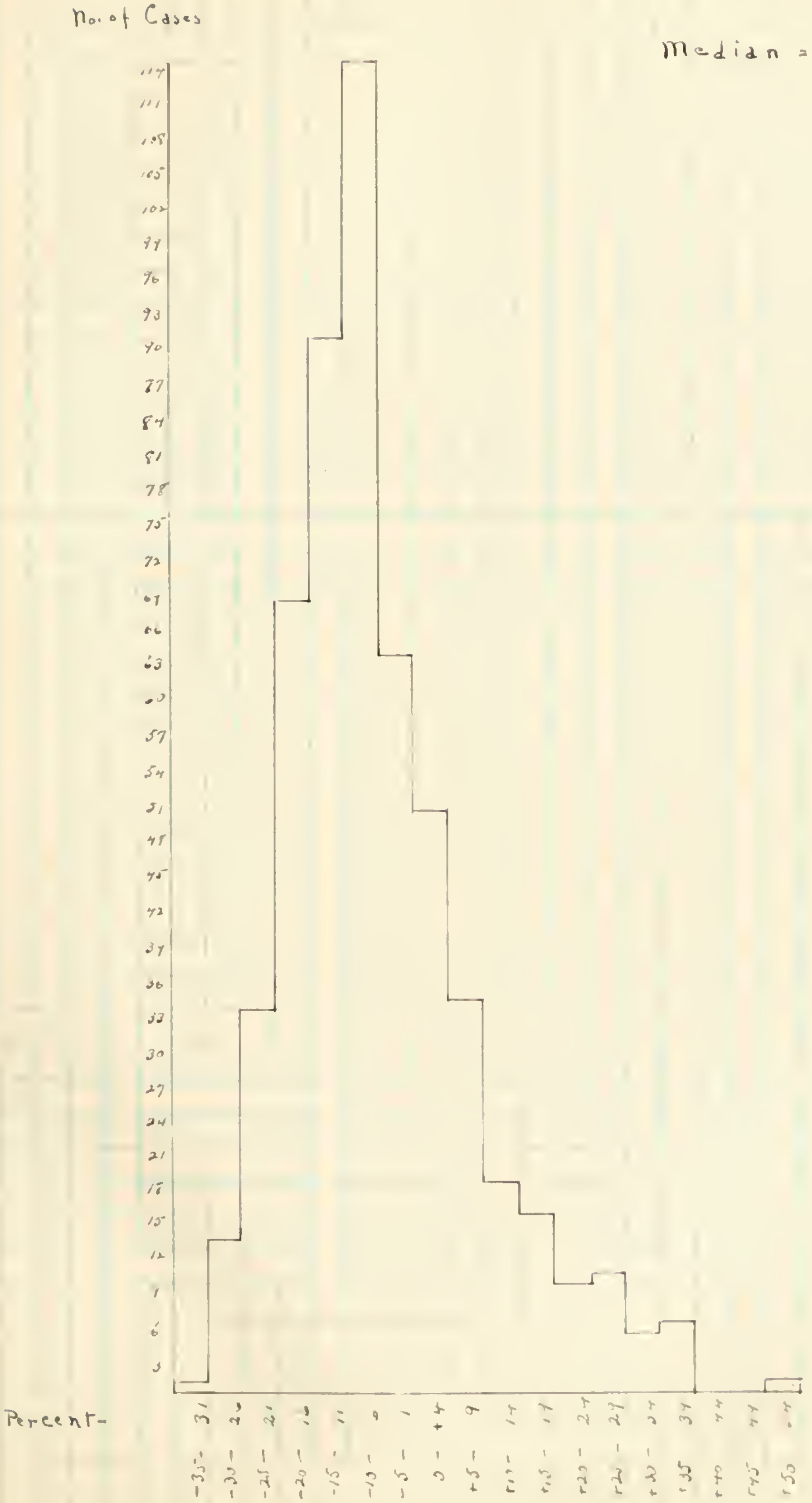


Percent Weight-Standing-height Distribution of 361 Gir

Median = -2%.



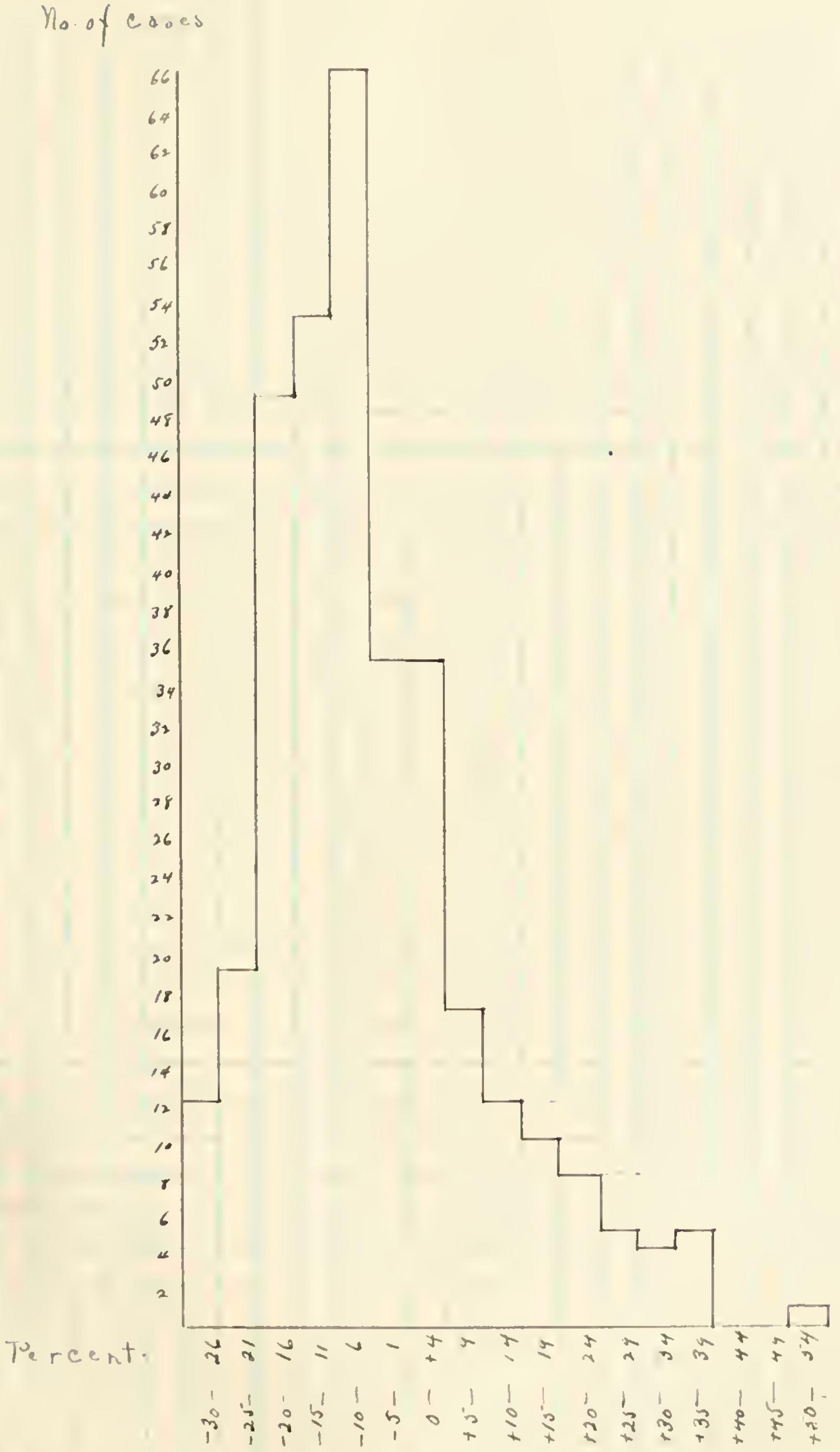
Percentage Weight-Trunk-Length Distribution of
530 Students (Boys and Girls)



Median = -8 %

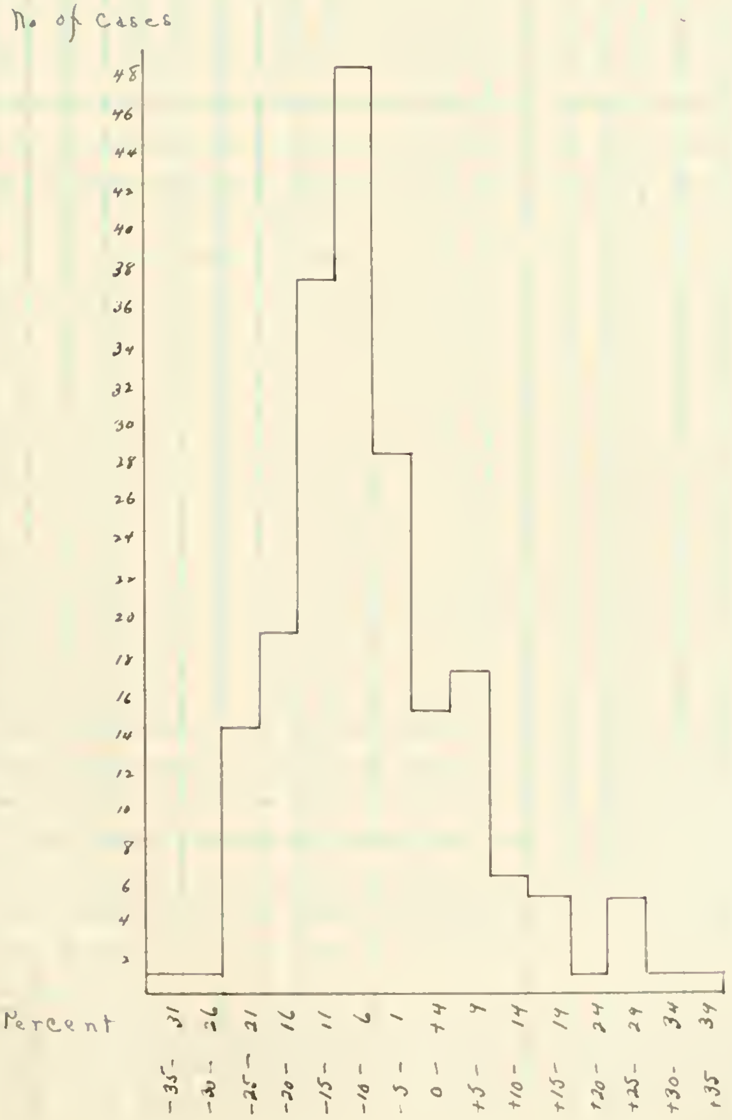
Percent Weight-Trunk Length Distribution of 331 Girls

Median = -8%



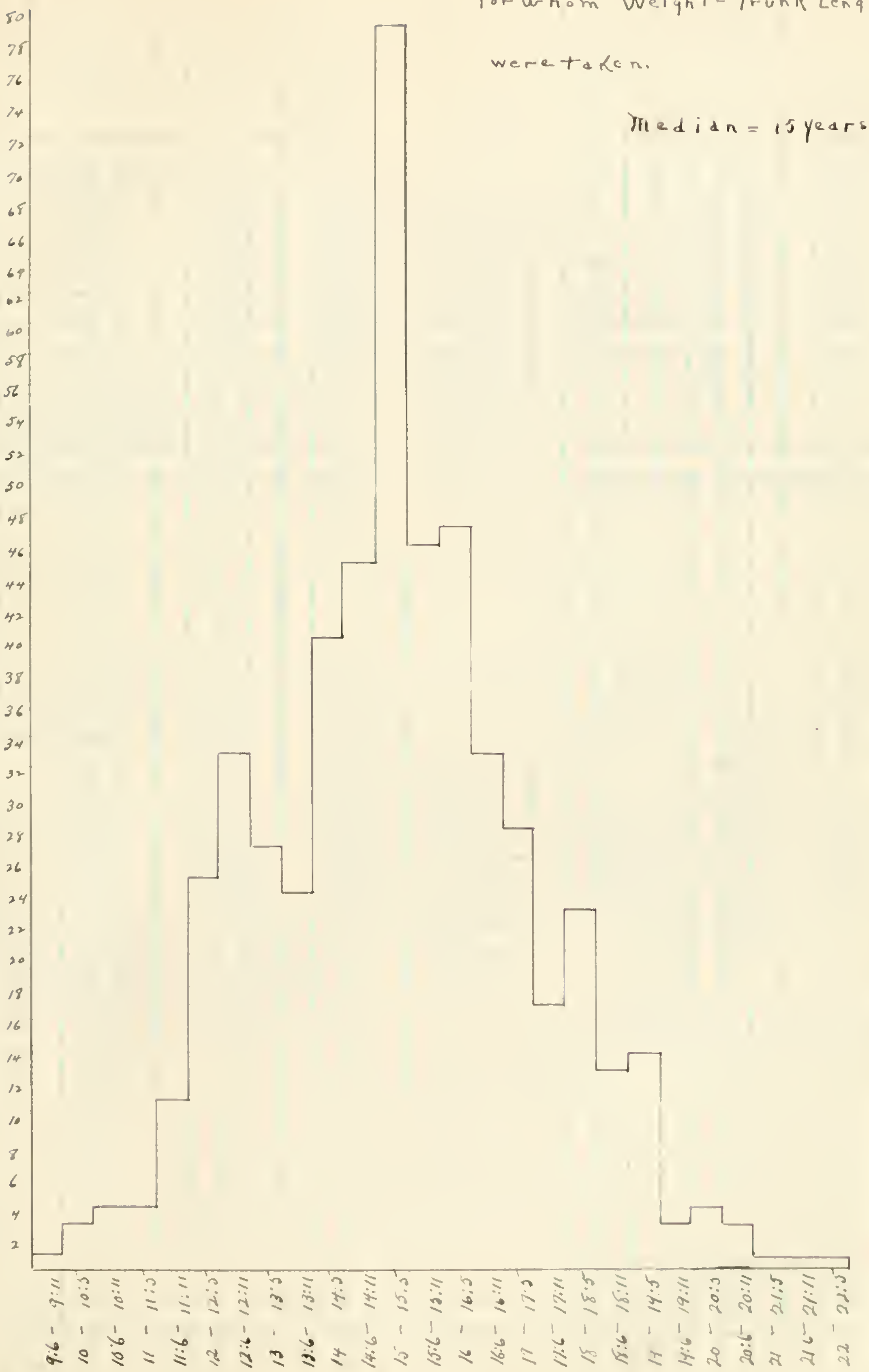
Percent Weight - Trunk Length Distribution of 199 Boys

Median = -8%



Age Distribution of 530 Students (Boys and Girls) for whom Weight-Trunk Length Measurements were taken.

Median = 15 years, 3 months



HEIGHT & WEIGHT TABLES COMPARED WITH THOSE OF CLARK

SYDENSTRICKER AND COLLINS

Age at nearest birthday. (years)	Height		Age	Height		No. Cases	
	Boys	Girls		Boys	Girls	Boys	Girls
11	54.3	54.5	11 1/2		57.5		16
12	56.2	57.0	12 1/2		60.1		43
13	58.0	59.3	13 1/2	59.3	61.3	23	45
14	60.3	61.1	14 1/2	62.7	63.5	38	70
15	62.9	62.5	15 1/2	64.9	64.8	36	62
16	64.6	63.3	16 1/2	66.8	64.6	14	48
			17 1/2		63.6		23
			18 1/2		63.2		28
			19 1/2				

Mean height of 14,335 native white children in Maryland, Virginia, North & South Carolina.

Boys and girls in West Virginia and Maryland

Age at nearest birthday (years)	Weight		Age	Weight		No. Cases	
	Boys	Girls		Boys	Girls	Boys	Girls
11	71.1	70.3	11 1/2		87.3		16
12	78.0	79.7	12 1/2		100.6		43
13	85.1	89.7	13 1/2	90.2	103.7	23	45
14	95.4	99.4	14 1/2	103.8	109.6	38	70
15	108.4	107.6	15 1/2	115.3	112.6	36	62
16	116.7	113.6	16 1/2	129.3	120.2	14	48
			17 1/2		120.8		23
			18 1/2		120.5		28
			19 1/2				

Mean weight of 14,335 native white children in Maryland, Virginia, North & South Carolina.

Boys and Girls in West Virginia and Maryland

Age at nearest birthday (years)	Wt-Ht Index		Age	Wt-Ht Index		No. Cases	
	Boys	Girls		Boys	Girls	Boys	Girls
11	1.31	1.29	11 1/2		1.50		16
12	1.39	1.40	12 1/2		1.65		43
13	1.47	1.51	13 1/2	1.52	1.68	23	45
14	1.58	1.63	14 1/2	1.64	1.74	38	70
15	1.73	1.72	15 1/2	1.77	1.78	36	62
16	1.81	1.79	16 1/2	1.92	1.83	14	48
			17 1/2		1.89		23
			18 1/2		1.92		28

It will be noted in the group studied, that on the average, the girls are taller than the boys at the age of 12 1/2 years to 14 1/2 years; and that the ages 12 1/2 to 14 1/2 the girls are also heavier. At 15 1/2 the boys go ahead of the girls in both height and weight. This is in accordance with the generally accepted laws of growth during the period of puberty. It will also be noted that the differences in the weight-height indices for the sexes occur approximately at the same ages as do the differences in height and weight taken singly.

Comparing this group with that of Clark, Sydenstricker, and Collins it is interesting to note that my group are both taller and heavier age for age, and in both sexes. One might be inclined to believe the increase was due to the inclusion of the private school pupils, as Gray found private school boys taller than public school boys. But the private school pupils in this study were only girls, so that explanation will not hold, as there is also about the same increase with the boys and all of the boys considered here were public school boys. To be sure there is a great difference in the number measured, nevertheless the variation is exceedingly interesting.

Correlations Between Intelligence Scores and Physical Measurements

Correlation of Otis I.Q. and Percentage Deviation of the Weight to Standing Height Ratio.

The correlation of the intelligent quotient derived from the Otis Group Intelligence Test and the percentage above or below the normal calculated from the weight-height index (Wood's Tables being used) of 151 Sophomores in high school gave a coefficient of -.184, P.E.± .05. The Otis I.Q.'s ranged from 69 to 144 with an average of 103.85 and standard deviation of 14.70. The percentage above or below the normal weight range is from -26 to + 50, with an average of -4.6 and σ 10.98.

When the correlation was made for the girls of this group separately the coefficient was -.183, P.E. ± .07 The I. Q. range for the girls was from 75 to 144, with an average of 103.71, and σ 15.33. The percentage above or below normal weight range was from -26 to + 50, with a mean of -6.5 and σ 12.75.

The correlation for the boys also being worked out separately the coefficient was found to be -.3, P.E. ± .07. The I.Q. range was from 69 to 138, the average being 104.12, σ 14.16. The weight percentage range was from -21 to + 8 with an average of -4.2, σ 8.04.

In general the correlation although negative means little. We are led rather to the conclusion that there is either no

correlation between physical standard of the ratio of height to weight and intelligence scores, or that the measure which we have for determining the one or the other of the terms mentioned above are inadequate to measure them.

Correlation of Otis I.Q. and the Percentage of Weight above or below the standard, in relation to trunk length using Dreyer's Tables.

When the correlation was computed between the I. Q. derived from the Otis Scores and the percentage above or below the standard weight for trunk as set by Dreyer's Tables of 152 Sophomores in High School it was found to be -.188, P.E. ±.05 with a range of 71 to 137 I.Q. , the average being 105.62 and standard deviation 13.32. The weight range was from -28 per cent to +36 percent, the average being -6.68 percent and a standard deviation of 12.87.

This group, too, was divided to discover any sex differences that might appear. The 81 girls had an I.Q. range of 73 to 133, an average of 106.26 and a standard deviation of 13.56, while their weight range was from -28 percent to + 36 percent, with an average of -5.45 percent and a standard deviation of 14.52. The correlation was -.219, P.E. ±.07. The boys had an I.Q. range of 71 to 137 with an average of 104.99 and a standard deviation of 13.95. Their weight range is from -23 percent to + 27 percent, the average being -6.98 percent and standard deviation 10.02. The correlation between these two measures is -.149, ±.07.

These results bear out the same general findings that appeared when the percentage of weight derived from the weight-height index was used. Again we find the greatest range among the girls, although in this case the number is almost equally divided between the boys and the girls. One difference, however, is noted. When the weight-height index standard of Wood's Tables was used the boys showed a minus (-.300±.07) correlation which was significant, indicating rather that the underweight boys made better scores on the intelligence test than the overweight boys, whereas when Dreyer's Tables are used the reverse appears. It is the girls who show the larger minus correlation (-.219,±.07).

Another item of interest in connection with the two types of physical measurements used is that the standing height measures and weights were made in the early autumn, late October, and the trunk length measures and weights were taken in the spring, late April. If the seasonal fluctuations are considered, that should show a larger percentage underweight in the spring. As a matter of fact we find the percentages showing up as follows:

	October Measurements	April Measurements
Boys and Girls	-4.6%	-6.68%
Girls	-6.5%	-5.45%
Boys	-4.2%	-6.98%

One sees the theory does not hold for the girls, although it does for the boys and for both sexes taken together.

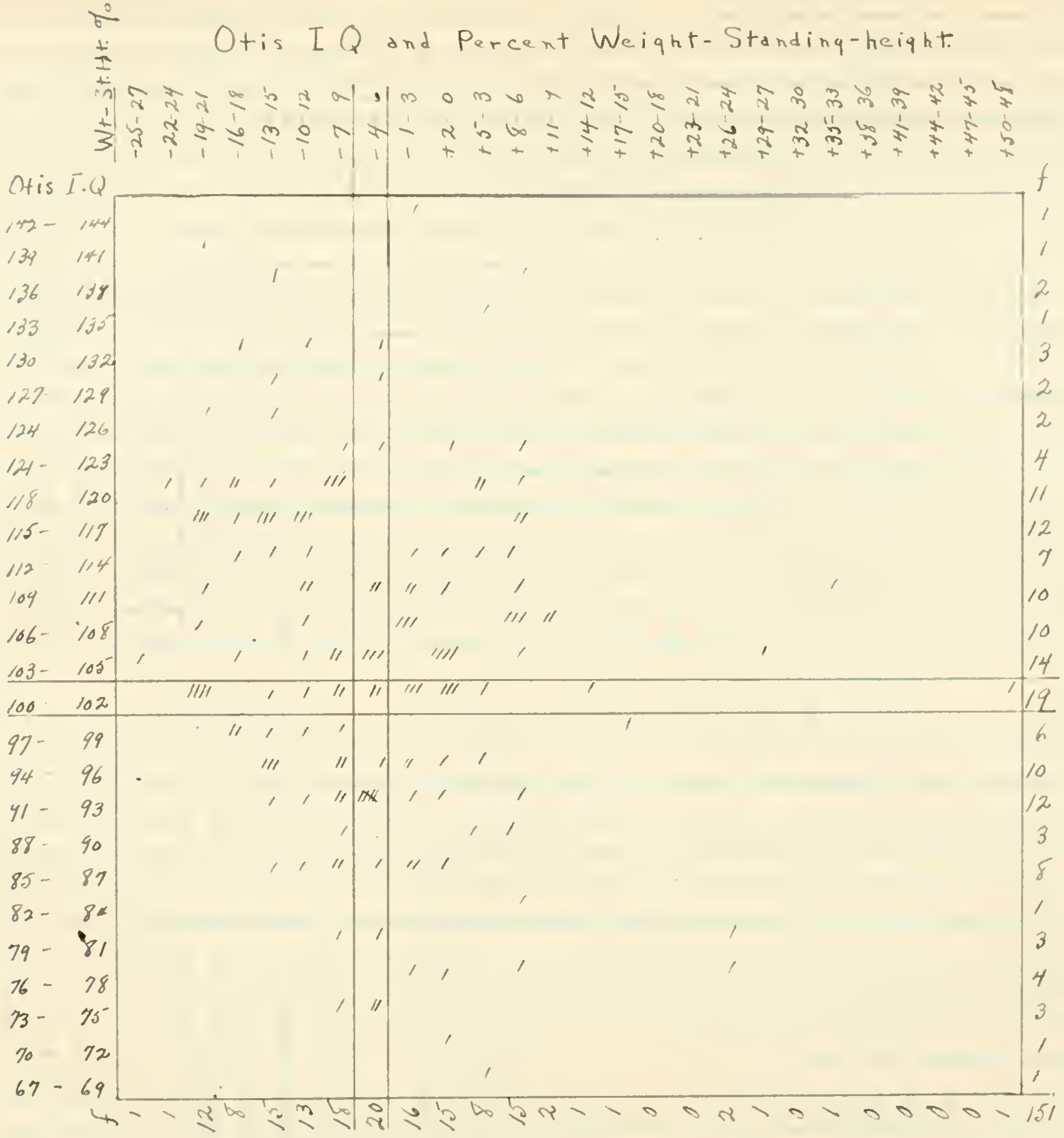
Correlation Table

Boys and Girls	Cases	Range	Average	S.D.	r. P.E.
Otis I.Q.	151	69 to 144	103.85	14.70	-.184 ± .05
Percent Weight (Wood's Tables)	151	-26 to + 50	-4.6	10.98	
Girls					
Otis I.Q.	82	75 to 144	103.71	15.33	-.183 ± .07
Percent Weight		-26 to + 50	-6.5	12.75	
Boys					
Otis I.Q.	69	69 to 138	104.12	14.16	-.300 ± .07
Percent Weight		-21 to + 8	-4.2	8.04	
Boys and Girls					
Otis I.Q.	152	71 to 137	105.62	13.32	-.188 ± .05
Percent Weight (Dreyer's Tables)		-28 to + 36	-6.68	12.87	
Girls					
Otis I. Q.	81	73 to 133	106.26	13.56	-.219 ± .07
Percent Weight		-28 to + 36	-5.45	14.52	
Boys					
Otis I.Q.	71	71 to 137	104.99	13.95	-.149 ± .07
Percent Weight		-23 to + 27	-6.98	10.02	

Boys and Girls - Sophmore High School

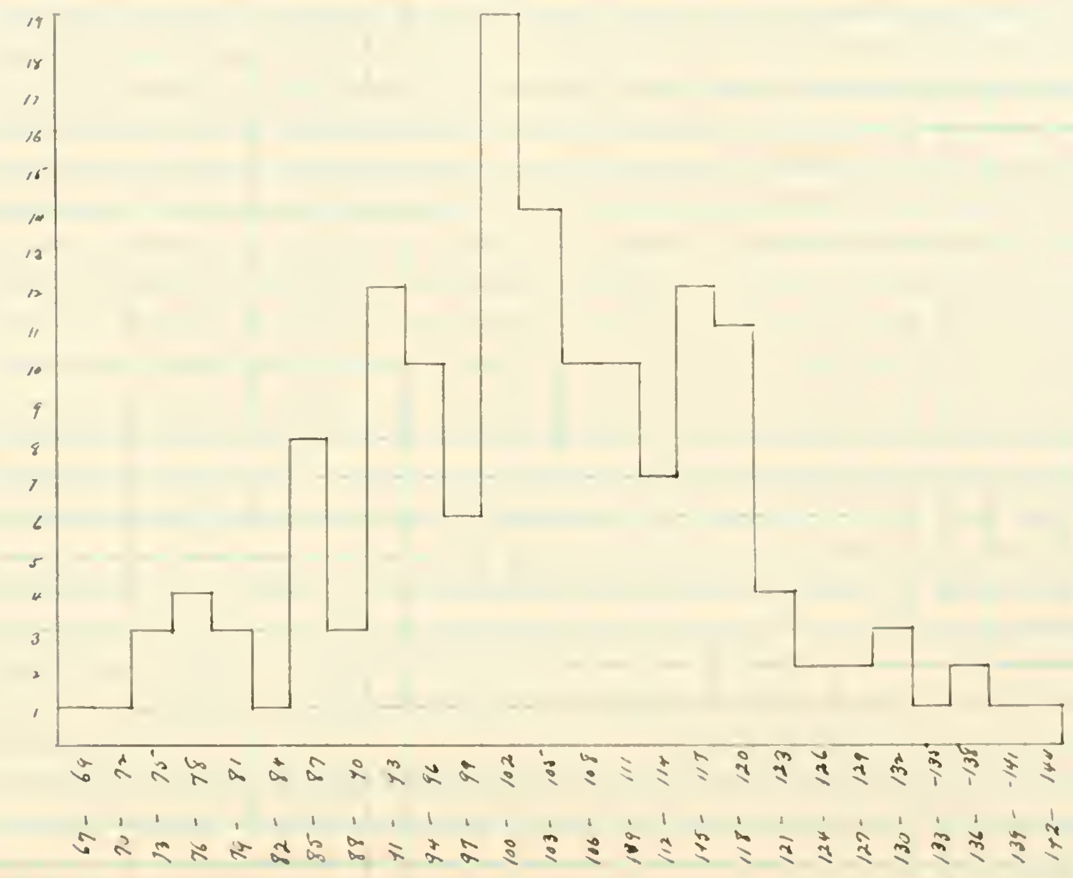
Otis I Q and Percent Weight-Standing-height.

r = -.184 ±.05



I.Q Distribution of 151 Sophmores in High School.
Boys and Girls

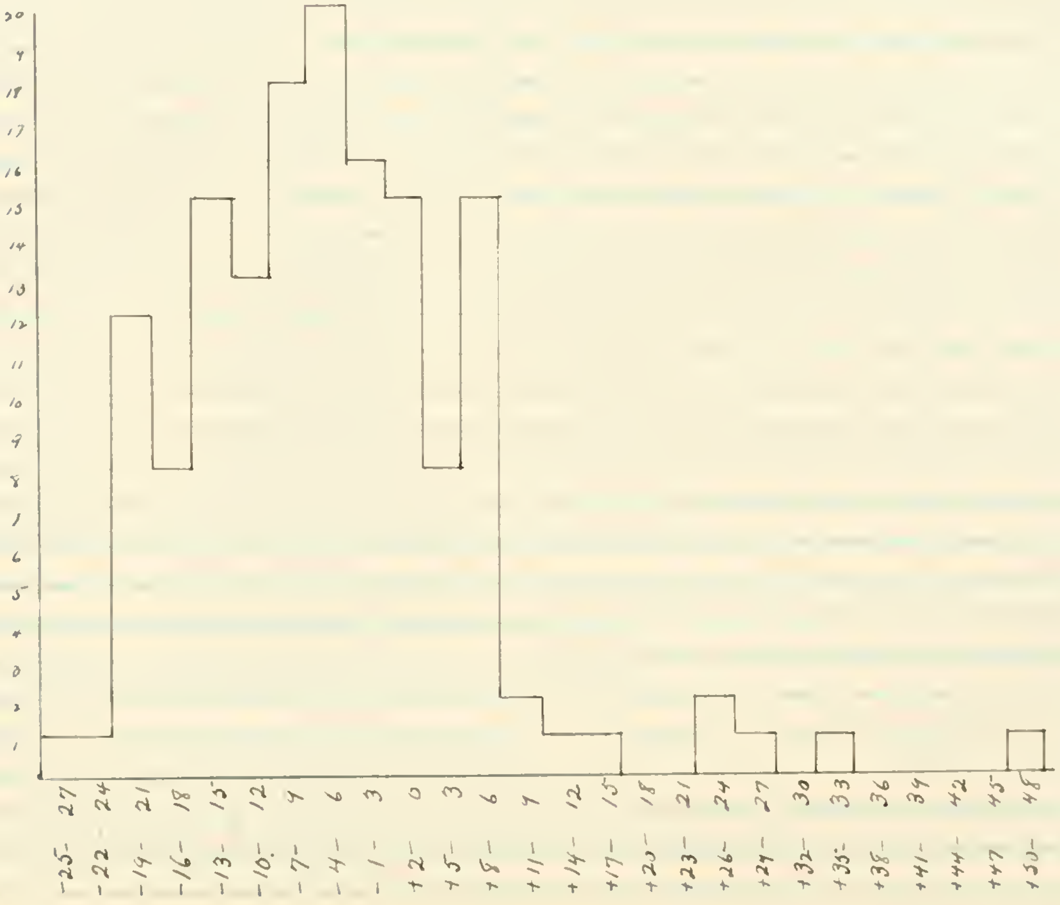
Average = 104 I.Q
$\sigma = 14.7$



Percentage Weight-Standing-height Distribution of

151 Sophmores (Boys and Girls) in High School.

Average = − 4.6
σ = 10.98



Girls - Sophmores in High School

Otis I.Q. and Percent Weight-Standing-height.

r = -.183, ±.07

	27	24	21	18	15	12	9	6	3	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	
	-25-	-22-	-19-	-16-	-13-	-10-	7-	-4-	-1-	+2-	+5-	+8-	+11-	+14-	+17-	+20	+23	+26	+29-	+32-	+35-	+38-	+41	+44-	+47-	+50-	f.
142- 144									/																		1
139- 141			/																								1
136- 138																											0
133- 135											/																1
130- 132				/		/																					2
127- 129					/																						1
124- 126					/																						1
121- 123							/			/		/															3
118- 120		/			/		/				//																5
115- 117			/	/	/	/						/															5
112- 114				/	/				/	/																	4
109- 111								/	/												/						3
106- 108			/			/			/			/	//														6
103- 105	/						//	//	///			/							/								10
100- 102			//		/		//	/		/				/												/	9
97- 99				/		/									/												3
94- 96					//		/	/	/	/	/																7
91- 93							//	///																			5
88- 90											/																1
85- 87					/	/	//		//																		6
82- 84																											0
79- 81								/										/									2
76- 78									/	/		/						/									4
73- 75							/	/																			2
f	1	1	5	4	9	5	12	10	8	8	5	5	2	1	1	0	0	2	1	0	1	0	0	0	0	1	82

Boys - Sophmores in High School

Otis I Q and Percent Weight-Standing-height.

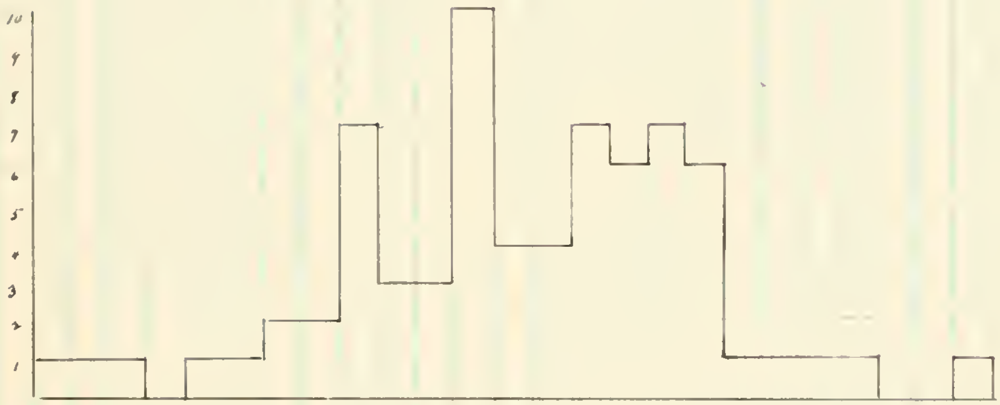
r = -.300 ± .07

Otis I.Q	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	f
136- 138			/							/	2
133- 135											0
130- 132						/					1
127- 129						/					1
124- 126	/										1
121- 123						/					1
118- 120	/	//			//					/	6
115- 117	//		//	//						/	7
112- 114				/					/	/	3
109- 111	/			//		/	/	/		/	7
106- 108							//			//	4
103- 105		/		/		/		/			4
100- 102	//			/		/	///	//	/		10
97- 99		/	/		/						3
94- 96			/		/		/				3
91- 93			/	/		//	/	/		/	7
88- 90					/					/	2
85- 87						/		/			2
82- 84										/	1
79- 81					/						1
76- 78											0
73- 75						/					1
70- 72								/			1
67- 69									/		1
f	7	4	6	8	6	10	8	7	3	10	69

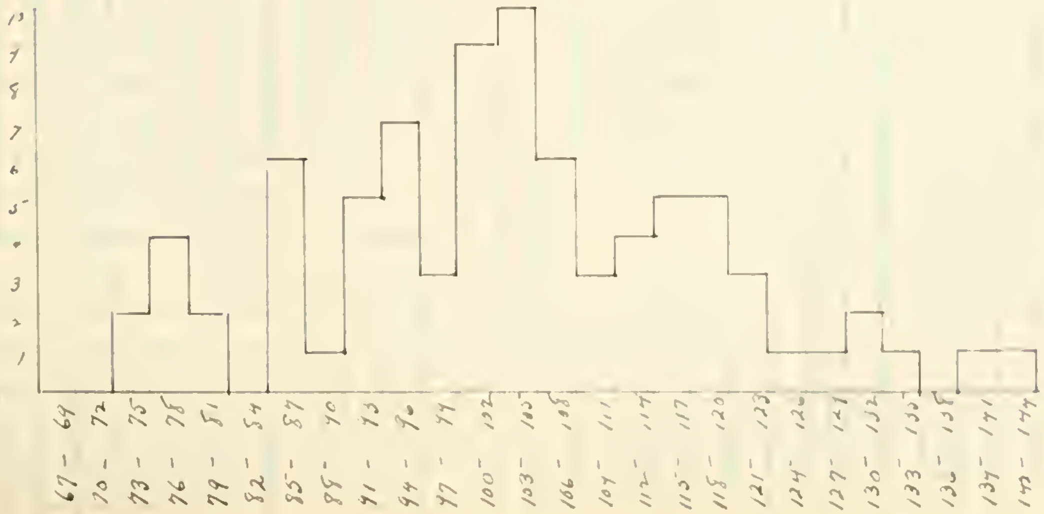
Otis I.Q Distribution of 69 Sophmore Boys in H.S.
" 82 " Girls " "

Average I.Q 104(Boys) σ 14.16
104(Girls) σ 15.33

69 Boys



- 82 Girls

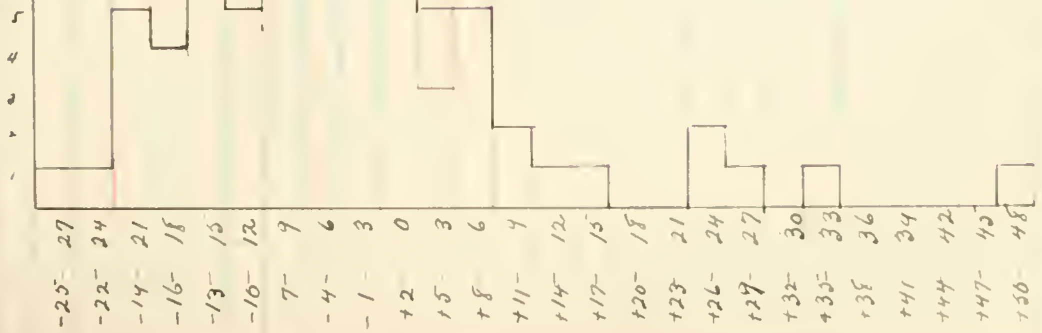


Percent Weight-Standing-height Distribution of

82 Sophmore Girls in High School.
69 " Boys " " "

Average = -6.5 % - Girls σ 12.75
-4.2 % - Boys σ 8.04

82 Girls
69 Boys



Boys + Girls - Sophomore - High School.

Correlation Otis IQ and Trunk Length-Weight Percent   r = -.188 PE ±.05

I. Q.	-28-30	-25-27	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	+38-36	
136-138							/																	1
133-135					/				/															2
130-132			/			/	/		//															5
127-129	/	/				/		/					/											5
124-126						//	/																	3
121-123						/	/			/	/													4
118-120			/	/	/	/	/	//		/	//			/										11
115-117			//	/			///	/	//		/								/					11
112-114		/		///	/		/	/		/	/	/		/	/									12
109-111				/		/		//	//					//	/									9
106-108	/				//	//	//	/		///			/									/		13
103-105		/		///	/	/	//	/		/	/							/						12
100-102		/	/		///	//	///	/	///	///				//						/				20
97-99					/		///			/										/			/	7
94-96			//					/				/		/										5
91-93			/	/		/		/	///	//	///			/										13
88-90			/				/	/		/		/		/				/						7
85-87		/					/	/																3
82-84												/												1
79-81							/										//							3
76-78				/			/	/											/					4
73-75					/																			1
70-72														/										1
	2	5	9	11	11	13	23	15	13	14	9	4	2	10	2	0	2	2	2	2	0	1	1	152

Girls - Sophomore - High School

Correlation Otis I.Q and Trunk Length - Weight Percent. r = -.219 ±.07

I.Q	-28-30	-25-27	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	+38-36	
133-135					/																			1
130-132			/			/	/		/															4
127-129	/	/				/		/																4
124-126						/	/																	2
121-123							/			/														2
118-120			/	/	/	/																		4
115-117			/	/			/	/			/													5
112-114		/		///				/		/														6
109-111				/		/								//										7
106-108	/				//		/	/		//												/		8
103-105		/		//	/		/	/		/	/							/						9
100-102		/	/		///	/	/	/	/											/				10
97-99					/		/																/	3
94-96			//					/						/										4
91-93			/	/		/		/						/										5
88-90			/				/					/						/						4
85-87		/																						1
82-84																								0
79-81																	/	/						2
76-78				/				/																2
73-75					/																			1
	2	5	8	10	10	7	9	9	2	5	2	1	0	4	0	0	1	3	0	1	0	1	1	81

Boys - Sophomore High School

Correlation Otis I.Q and Trunk Length - Weight Percent.

r = -.149, ±.07

I. Q.	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23 21	+26-24	+29-27	+32-30	
136-138					/															1
133-135							/													1
130-132							/													1
127-129											/									1
124 126				/																1
121-123				/					/											2
118-120					/	//		/	//			/								7
115-117	/				//		//										/			6
112-114			/		/				/	/		/	/							6
109-111						//	//						/							5
106-108				/	/			/			/									4
103-105		/		/	/															3
100-102				/	//		//	///				//								10
97-99					//			/										/		4
94-96										/										1
91-93						/	///	/	///											8
88-90						/		/				/								3
85-87					/	/														2
82-84										/										1
79-81					/															1
76-78					/												/			2
73-75																				0
70-72												/								1
	1	1	1	5	14	7	11	8	7	3	2	6	2	0	0	0	2	1	0	71

CORRELATION OF THE NATIONAL INTELLIGENCE I.Q. AND PERCENTAGE DEVIATION OF THE WEIGHT TO STANDING HEIGHT RATIO.

The correlation of the I.Q. derived from the National Intelligence score Form A, and the percentage above or below the normal weight-height index of 139 junior high school pupils is +0.021, P.E. ± .05. The I. Q.~~s~~ ranged from 75 to 148 with a mean of 106.85 and a standard deviation of 4.94. The weight range is from -26 percent to +53 percent, with a mean of -1.64 percent and a standard deviation of 4.07. The age range is from 11 years, 1 month to 16 years, 7 months.

The correlation for the measures above of the 84 girls alone is -0.073, P.E. ± .07. The I.Q. range is 78 to 148, with a mean of 107.21 and a standard deviation of 14.75. The weight percentage ranges from -26 percent to +53 percent, with a mean of +0.17, and standard deviation of 13.50. The age range is from 11 years 1 month to 16 years 2 months.

For the 55 boys the correlation is +0.191, P.E. ± .08. The I.Q. range is from 75 to 130, with a mean of 102.89 and a standard deviation of 14.40. The range of the percentage of weight above and below normal is from -24 percent to +30 percent, with a mean of -4.34 percent and a standard deviation of 9.50. The age range is from 12 years 1 month to 16 years 7 months.

The correlation for the group as a whole is positive, for the girls it is negative and for the boys it is positive, but in all cases it is insignificant.

CORRELATION OF THE NATIONAL INTELLIGENCE I.Q. AND THE PERCENTAGE OF WEIGHT ABOVE OR BELOW THE STANDARD IN RELATION TO TRUNK LENGTH USING DREYER'S TABLES.

The I.Q. of 120 junior high school pupils derived from scores made on National Intelligence Test, Form A, and the percentage above or below the standard, when compared with Dreyer's Tables gave a correlation of -0.129, P.E. ± .06. The I.Q. range was from 75 to 148, with an average of 102.08 and a standard deviation of 5.05. The percentage above or below normal weight had a range from -32 percent to +53 percent, with an average of -9.44 and a standard deviation of 4.25. The age range of this group is from 11 years 5 months to 17 years 1 month.

When this group was divided into the two sexes, it was found that the correlation for the 42 girls was -0.218, P.E. ± .09. The I.Q.'s range from 76 to 148 with an average of 102.21, and a standard deviation of 15.61. The percentage of weight range is from -30 percent to +53 percent, with an average of -8 percent, and a standard deviation of 15.96. For the 78 boys the correlation is -0.058, P.E. ± .07. The I.Q. range is from 75 to 136, with an average of 102.02, and a standard deviation of 14.72. The range of the percentage of weight is from -32 percent to +34 percent with an average of -10.88 percent and a standard deviation of 10.51. Here we note all correlations are minus ones, but insignificant.

One sees by these correlations that they are not unlike those obtained when the Otis I.Q. was used as a standard for mental development. Apparently there is little difference between the Otis and the National Intelligence Tests, and while the Dreyer Tables give consistently lower ratings for the percentage of weight, they seem to influence the correlation little or none. For example, with the sophomores when Wood's Norms were used the correlation was -0.184, P.E. ± .05, and when Dreyer's Tables were taken as a standard the correlation was -0.188, P.E. ± .05. The results are not quite so similar for the junior high school pupils. There Wood's Tables gave a correlation of +0.021, P.E. ± .05, while Dreyer's gave -0.129, P.E. ± .06.

It must be recalled, however, that the two groups while they contain many of the same children, are not identical. Whether the results would have been more or less uniform had the groups been identical it is difficult to say. One is inclined to think they would be about as they appear above judging from the private school correlations.

As much as one can say about the results is that there is a very slight tendency for the pupils who are slightly underweight, as determined by these norms, to have higher I.Q.'s as far as they can be determined by these two general intelligence tests.

CORRELATION TABLE FOR JUNIOR HIGH SCHOOL PUPILS

Boys & Girls	Cases	Range	Mean	S.D.	r	P.E.
National I.Q.	139	75 to 148	106.85	14.85	+0.021	±.05
Percent Weight (Woods Tables)	139	-26 to +53	-1.64	12.21		
Girls						
National I.Q.	84	78 to148	107.21	14.75	-0.073	±.07
Percent Weight (Wood's Tables)	84	-26 to +53	+0.17	13.50		
Boys						
National I.Q.	55	75 to 130	102.89	14.40	+0.191	±.08
Percent Weight (Wood's Tables)	55	-24 to +30	-4.34	9.50		
Boys & Girls						
National IQ.	120	75 to 148	102.08	15.15	-0.129	±.06
Percent Weight (Dreyer's Tables)	120	-32 to +53	-9.44	12.75		
Girls						
National I.Q.	42	76 to 148	102.21	15.61	-0.218	±.09
Percent Weight (Dreyer's Tables)	42	-30 to +53	-8.00	15.96		
Boys						
National I.Q.	78	75 to 136	102.02	14.72	-0.058	±.07
Percent Weight (Dreyer's Tables)	78	-32 to +34	-10.88	10.51		

Boys and Girls - Junior High School.

Standing-height - Weight Percent and I.Q.

	73-75	76-78	79-81	82-84	85-87	88-90	91-93	94-96	97-99	100-102	103-105	106-108	109-111	112-114	115-117	118-120	121-123	124-126	127-129	130-132	133-135	136-138	139-141	142-144	145-147	148-150	
1													/														-25-27
3	/							/						/													-22-24
2										//																	-19-21
4						/			/					/					/								-16-18
9			/			///	/					/				/	//										-13-15
16				/			/	/	//	/		/	/	///	/		/	//		/							-10-12
16	/		/			//	/	/		//	/	///	/		/	/										/	-7-9
15		/					///		///	/	/		/		/	//	/	/	/								-4-6
23			·	/	/	/			/ 卌	/	/	///	//		//		/	//	/								-1-3
12			/	//					/				///	/	//			//									+2-0
9			/		/		//	/	/		/		/				/										+5-3
5										/			///												/		+8-6
9										///	/				/			/	/	/	/						+11-9
5							/	/					/			/		/									+14-12
2											//																+17-15
0																											+20-18
2					/											/											+23-21
2			/											/													+26-24
0																											+29-27
1															/												+32-30
0																											+35-33
1														/													+38-36
0																											+41-39
1									/																		+44-42
0																											+47-45
0																											+50-48
1			/																								+53-51
139	2	1	6	4	3	7	9	5	15	11	7	8	14	8	9	6	6	9	4	2	1	0	0	0	1	1	

Boys and Girls Junior High School

Trunk Length —Weight % and I.Q.

	-34-36	-31-33	-28-30	-25-27	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	+38-36	+41-39	+44-42	+47-45	+50-48	+53-51	
148-150				/																											1
145-147																															0
142-144																															0
139-141																															0
136-138				/																											1
133-135										/		/				/															3
130-132		/																													1
127-129							/																								1
124-126							/	/	/																						3
121-123								/	/		/																				3
118-120								/		/			/																		3
115-117							///		///	/	/		/								/										10
112-114					//		/	/	/		//			//																	9
109-111					//			/	//			/																			6
106-108					/	/	/	/		/	//																				7
103-105					/			//		/	/	/					/														7
100-102			/			/	//	//		/	/	/																			9
97-99			//				/		/	/	///		///		/																12
94-96				/				/	/	/							/														5
91-93					//		//	//	/	//																					9
88-90					//	//				/	/				/									/							8
85-87					/			//		//					/									/							7
82-84				/							//																				3
79-81						/	/	/		/	//						/													/	8
76-78					/					/																					2
73-75								/		/																					2
		1	3	4	12	5	13	17	11	16	16	4	5	2	3	1	3	0	0	0	1	0	0	2	0	0	0	0	0	1	120

Private School Pupils

The private school group of girls was studied separately as far as the relation of physical amd mental development is measured by standard norms. This was done for several reasons: (1) they all come from well-to-do homes and it was thought a comparison with the public school children would be especially interesting, (2) the school is an open air school, (3) all measurements were made at one time.

Because of the small number of nine and ten year old children, none of the nine year old children were included and of the ten year old group only those whose nearest birthday was eleven years.

The group is represented by girls from the fifth grade up through high school, with an age range from ten years and seven months to twenty years.

Considering first the correlation between the standing-height-weight percent deviation (Wood's Tables) and the trunk length-weight percent deviation (Dreyer's Tables) for 132 cases, we find it to be +0.756, P.E.±.025. This is the same that was obtained for the college freshmen, which fact is quite interesting, in as much as the age range for the two groups is quite different. The college students ranged from 17 years to 21 years of age.

The correlation is perhaps as high as one would expect to find it when one considers that two distinct measures are being compared, for certainly trunk length and complete stature ane not equally proportional.

The correlation between the standing-height-weight percent deviation and I.Q., derived from the norms of the National tests, was -0.136, P.E. ± .057. The I.Q. ranged from 77 to 138 with a mean of 108.89 and a standard deviation of 11.40. The percentage deviation above and below the normal weight-height index ranged from minus 27 to plus 35 percent with a mean of +0.52.

This mean percentage of weight approximates that of the 84 junior high school girls (+0.17%). But it differs considerably from that of the 82 Sophomore girls of the public schools. (-6.5%).

The correlation between the I.Q. and the percent deviation in weight when the trunk-length-weight ratio was used (Dreyer's Tables) was +0.033, P.E. ± .058. The I.Q. range was the same as the above, as the same individuals were measured. The percentage weight range was from minus 25% to plus 39 %, a slightly greater range than when the Wood's Tables were used. The mean was -1.22 percent and the standard deviation was 13.59.

For the private school girls the mean deviation in weight is practically the same with the two standards, and the range is almost the same. The mean percentage for the college freshmen when the trunk length was used does not so closely resemble that of the private school, it being -4.61 percent; for the sophomore girls in high school it was -5.45 percent and for the junior high school girls it was -8 percent. This certainly looks as if the girls of the private

school were superior physically to the public school pupils and college freshmen if Dreyer's Tables are accepted as standards. Whether this superiority is due to the open air school, to the hot noon dinner which many of them take at school, or to their home environment and heredity we have no means of determining.

It is rather surprising, however, to find the I.Q. range not higher. Two of the junior high school pupils had higher scores than any of the private school pupils. Thisfact may be more apparent than real. Had there been norms above 136 points there would have been higher I.Q.s. Of the 38 girls above 16 years of age all had scores above 136 points except three, the 22 fifteen year old girls all had scores above 136; of the 18 fourteen year olds only two were below 136; only two of the 15 thirteen year olds were below 136; of the 25 twelve year old girls 12 had scores above 136, and two out of 10 of the eleven year old girls made scores above 136. Only the younger children could earn a high I.Q., for by accepting 136 as earning a mental age of 15 years 6 months, all of the girls past that age could not earn an I.Q. of more than 100, although the scores ran as high as 183 points.

So far as correlations are concerned, however, whether with one physical standard or the other in use they are too low to be significant. With Wood's tables it is a minus correlation, while Dreyer's give a plus.

CORRELATION TABLE FOR PRIVATE SCHOOL GIRLS

	Cases	Range	Mean	S.D.	r	P.E.
Percent Weight (Wood's Tables)	132	-27 to +35	+0.52	11.79	+0.756	±.025
Percent Weight (Dreyer's Tables)	132	-25 to +39	-1.22	13.59		
National I.Q.	132	77 to 138	108.89	11.40	-0.136	±.057
Percent Weight (Woods Tables)	132	-27 to +35	+0.52	11.79		
National I.Q.	132	77 to 135	108.89	11.40	+0.033	±.058
Percent Weight (Dreyer's Tables)	132	-25 to +39	-1.22	13.59		

PERCENTAGE TABLE

Private School Girls-Ages 10:7 - 20

Standards	Cases	10% and below	-9% to + 20%	20% and above
Wood's	132	15.15	77.27	9.84
Dreyer's	132	29.54	59.84	10.60

Private School Girls – Percent. Weight-Trunk Length and I.Q.

r = +.033, P.E ±.058

	-25-27	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17 15	+20-18	+23-21	+26-24	+29-27	+32-30	+35+33	+38-36	+41-39	
136-138													/											1
133-135					/					/													/	3
130-132						//			/								/							4
127-129							//				//													4
124-126						/		/	/	/		/	/			/								7
121-123				/			//		/	//					/									7
118-120					/	/		/		/						/								5
115-117				/			/			//	//													6
112-114			/	//		//	//	/	/	/									/					11
109-111		/		//					/			/	/	/			/							8
106-108						/	/	/			/	/						/				/		7
103-105	/		/		///		//	//	/	//	/		/	/	/	/								17
100-102			/	//	𝍸	𝍸	////	𝍸 /	𝍸	///	///		//	/		/		/	/			/		41
97-99				/					/															2
94-96			/		/						/										/			4
91-93						/																		1
88-90																				/				1
85-87							/																	1
82-84																								0
79-81							/																	1
76-78																	/							1
	1	1	4	9	11	13	16	12	12	13	10	3	6	3	2	4	3	2	2	1	1	2	1	132

Private School Girls – Percent. Weight-Standing Height and I.Q.

r = – 0.136 P.E. ± .057

	-25-27	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	
136-138													1									1
133-135								1			2											3
130-132				1				1		1				1								4
127-129				1				1	1	1												4
124-126						1	2	1	1			1					1					7
121-123			1				2	2				2										7
118-120					1		1	1			1						1					5
115-117							1	2	1		2											6
112-114						1	4	2	2					2								11
109-111	1				1		1	1		1		1		1						1		8
106-108							1					2		1		1		1			1	7
103-105			1		1	3	3		1	1	2	1		1	1	2						17
100-102			1	1	1		6	4	6	3	8	5		2	2	1					1	41
97-99					1		1															2
94-96					1				1						1				1			4
91-93						1																1
88-90																					1	1
85-87						1																1
82-84																						0
79-81										1												1
76-78															1							1
	1	0	3	3	6	7	22	16	13	8	15	12	1	8	5	4	2	1	1	1	3	132

Girls - Private School

Correlation: Percent. Weight-Trunk Length - Dreyer's Tables.
with
Percent. Weight-Standing-height-Wood's Tables

$r = +0.756$, P.E. ± .025

Wood eyer	-25-27	-22-24	-19-21	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	+38-36	+41-39	
+41-39											/													1
+38-36															/						/			2
+35-33																			/					1
+32-30																					/			1
+29-27												/		/										2
+26-24																		/			/			2
+23-21														/	/					/				3
+20-18																//	//							4
+17-15												/		/										2
+14-12								/						/	/									3
+11-9					/							//	/	/		/								6
+8-6												///												3
+5-3								//		/	////	/		/	/									10
+2-0							///	///	//		//	///												13
-1-3							////	//	//	/	/	/		/										12
-4-6						/	///		/	//	////					/								12
-7-9			/	/	/	/	𝍸	/	///	/	//													16
-10-12				/	/	/	//	//	///	/				/	/									13
-13-15				/		/	////	//	//		/													11
-16-18			/		//	/	/	//		//														9
-19-21			/		/	/		/																4
-22-24	/																							1
-25-27					/																			1
	1	0	3	3	7	6	22	16	13	8	15	12	1	8	5	4	2	1	1	1	3			132

Freshmen College Students

The following physical measurements were made on the freshmen college students; standing height, trunk length, weight without clothing, chest circumference and vital capacity. All of these were made the same day.
The intelligence tests that were given to them were the Columbia Intelligence Test, Form B and the Hopkins tests: Number Tests I and II and the Omitted Letter Test, Memory Tests I and II and the Symbol Tests I and II. These were given shortly after the physical measurements were made.

The percentage above or below weight was computed by the various standards. (1) The weight-height index was compared with the weight-height index derived from Wood's Tables and the percentage above or below normal obtained. As there were some students more than 18 years of age, and as Wood's Tables end with age 18, the Life Insurance standards were used for the "adult" students. (2) The percentage above or below weight was computed from Dreyer's Tables, using only trunk length and weight. (3) The Percentage above or below standard weight was computed from Dreyer's Tables using the average of the trunk length plus the chest circumference and weight, or the complete Dreyer Formula. (4) The percentage above or below the norm for vital capacity was computed by using Dreyer's Tables for trunk length plus chest measurement and vital capacity.

A comparison of these various physical standards were made and the following results obtained.

	Cases	Range Percent	Average	S.D.	r.	P.E.
(1) Weight-height Index (Wood's Tables)	51	-18 to 35	1.87%	10.77		
					+ 0.757,	±.04
(2) Weight-Trunk Length (Dreyer's Tables)	51	-30 to 32	-4.61%	12.27		
(3) Weight-Trunk Length (Dreyer's Tables)	46	-30 to 32	-4.04%	12.65		
					+ 0.563,	±.06
(4) Weight-Trunk Length (Dreyer's Tables)	46	-31 to 11	-13.67%	11.20		

These correlations between the various physical standards show that the same thing is being measured. It is somewhat surprising that the correlation between Dreyer's two standards does not exceed 0.563, P.E.±.06 The difference in the averages is quite significant - a difference between -4.04% and -13.67%. Here it was especially noticeable that when the chest circumference was used in conjunction with the trunk length, it was the obviously fat girls who were most underweight. To cite one case:

Girl: Age: 18 years 8 months

Standing height: 60 inches

Trunk length: 31.8 inches

Weight: 138 pounds

Chest measurement: 34 inches

Vital capacity: 2600 c.c.

Her percentage of weight was the following with the various standards.

Weight-Height index: + 26 percent
(Wood's Tables)

Weight-Trunk Length: + 32 "

Weight-Trunk Length &
chest circumference: -14 "

Vital capacity: -27 "

Correlations between the various physical standards and the Columbia Intelligence Scores were secured. There was a minus correlation in every case but the amount of the correlation varied.

College Freshmen

Correlations between several physical standards & Columbia Intelligence Scores, Form B.

Physical Standard	Cases	Range	Average	S.D.	r.	P.E.
Weight-Height Index Percentage of Normal (Wood's Tables)	47	-18 to 35	2.32	10.8	-0.132	±.09
Weight-Trunk Length (Dreyer's Tables)	52	-30 to 32	-4.75	12.25	-0.312	±.08
Weight-Trunk Length & Chest Circum. (Dreyer's Tables)	46	-31 to 11	-13.69	11.2	-0.4[illegible]9	±.07
Vital Capacity	33	-29 to 25	-4.93	12.[illegible]0	-0.2[illegible]	±.1[illegible]6

The correlation with the weight-trunk length plus chest circumference is the most significant one, and but for the

fact that when the chest circumference was included the results seemed doubtful, it might have been the most useful. Even though minus it showed a correlation that might bear investigation.

The correlation ofthe nexthighest significance is that of Dreyer, using weight and trunk length. It was,therefore, decided to use it as the physical standard with which to correlate the Hopkins tests. Fifty-two cases were used. The following table shows the results, in the order in which the tests were given.

Tests	Possible Score	Range	Average	S.D.	r.	P.E.
Number Test I		31-170	85.01	26.21	-0.168	.09
Symbol Test I	72	22-56	39.59	6.55	-0.168	.09
Memory I	72	8-72	41.69	21.09	-0.057	.09
Symbol Test II	72	27-57	43.23	6.57	-0.246	.08
Memory II	72	0-72	55.5	19.49	-0.049	.09
Omitted Letter	63	21-61	38.36	37.44	-0.0909	.09
Number Test II		36-214	107.92	31.56	-0.159	.08

While the results are all negative they are so low as to be of little or no value. It simply means that with special tests as well as with so-called general intelligence tests there is no correlation between the physical state of development as measured by the relation of trunk length and weight and intelligence as measured by these specific tests.

To be sure, one might argue that the intelligence tests are not tests of intelligence and therefore the above state-

ment as to the relation of the physical and mental development will not stand. Yet when we consider that correlations as high as 0.65 have been obtained between intelligence tests and scholastic attainment, we are forced to admit the intelligence tests do test some ability whatever it may be called, which is necessary to success in intellectual pursuits. Unfortunately the writer has not been able to secure any metrical studies which show that relations between percentage above or below weight of the norms in use and a state of health have been worked and statistically. This leads us to suppose that the norms we have are inadequate, or that a percentage below the normal weight does not seriously handicap one, or that there is some compensatory factor such as glandular secretions which accounts both for the underweight and the mental activity, or else that there is no relation of any significance between the physical and mental development.

The purpose of the various Hopkins tests will be recalled. It was thought that the difference between the first and last Number Tests would show whether or not fatigue had entered by affecting the power of attention. To estimate this the score from the last test was deducted from the score in the first test, the result being recorded plus or minus. There was a range of -54 to + 7, with an average of -22.9, showing that fatigue did not injure the subject's attention, but indicating rather that practice had had its effect in securing an increase in score.

The differences between the two Symbol Test scores were

also computed with the idea of noting the effect of interference in learning, as the same key letters had been used for the two different symbol sheets. This test of substitution is a test to bring out the quickness of learning. First, it determines the speed with which a learner can build up new associations; second, it is in part a memory test. This difference was likewise obtained by deducting the second score from the first score and recording the difference as plus or minus. There was a range of -24 to + 8, and an average of -3.63. Here again we find there was no interference.

Then the difference between the two Memory Tests was found to show no interferance, but rather favorable practice effects. The range was -59 to + 20 with an average of -10.34

Finally the correlation between the differences of these three types of tests and the percentage of weight were correlated. The results are recorded below.

Test	Range	Average	S.D.	r.	P.E.
Difference Number Test I & II	-54 to + 7	-22.9	13.08	+ 0.046	± .09
Difference Symbol Test I & II	-24 to + 8	-3.63	6.46	+ 0.080	± .09
Difference Memory Test I & II	-59 to + 20	-10.34	22.25	+ 0.048	± .09

While these correlations are so low there is no significance to be attached to them, the fact that they are plus indicates that those who are most underweight tend to do slightly better or to make greater gain in the last test over the first than those who measured up to or above the standards of weight.

College Freshmen - Correlation between

Intelligence Scores and Percent. Weight - Trunk-Length -

Dreyer's Tables. r = -.312 P.E ±.08

	-28 - 30	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	+26 - 24	+29 - 27	+32 - 30	
108 - 110	/						/															2
105 - 107						/		/														2
102 - 104																						0
99 - 101																						0
96 - 98																						0
93 - 95																						0
90 - 92	/				/		//		//	/	/		/									9
87 - 89													/									1
84 - 86					/						/		/			/						4
81 - 83					/			/			/											3
78 - 80					/	/	//				/										/	6
75 - 77							//															2
72 - 74			/			/		/				/										4
69 - 71					/		/				/							/				4
66 - 68								//	/													3
63 - 65					/				/			/										3
60 - 62						/		/								/						2
57 - 59																/						1
54 - 56								/	/			/		/								4
51 - 53																/						1
48 - 50													/									1
	2	0	1	0	6	7	6	7	3	1	5	3	4	·	0	3	0	1	0	0	1	52

Correlation: Intelligence Scores - Thorndike - Form B and Percent Weight Derived from Standing-height and Weight Indices of Wood's Tables of 47 College Students. $r = -.132 \pm .09$

	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	
	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	f
108-110			1																1
105-107	1																		1
102-104																			0
99-101																			0
96-98																			0
93-95																			0
90-92		1	1		11		1			11									7
87-89											1								1
84-86				1						11								1	4
81-83						1	1					1							3
78-80					1		111			1					1				6
75-77				1															1
72-74	1						11		1										4
69-71				1	1					1							1		4
66-68								1	1	1									3
63-65				1	1		1												3
60-62					1			1											2
57-59										1									1
54-56						11		1			1								4
51-53								1											1
48-50						1													1
f	2	1	2	4	6	4	8	4	2	8	2	1	0	0	1	0	1	1	47

Correlation: Percent Above or Below Normal Weight Derived
t-Ht. Indices-Wood's Tables and " " " " " " "
from Dreyer's " , using Weight: Trunk Length of 51 College students

r = +0.757, P.E. ±.04

Wood	-16-18	-13-15	-10-12	-7-9	-4-6	-1-3	+2-0	+5-3	+8-6	+11-9	+14-12	+17-15	+20-18	+23-21	+26-24	+29-27	+32-30	+35-33	
Dreyer	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	f
+32-30															/				1
+29-27																			0
+26-24																			0
+23-21																	/		1
+20-18																			0
+17-15								/		/								/	3
+14-12																			0
+11-9								/	/										2
+8-5						/	/			/	/								4
+5-3							/		/		/								3
+2-0										////		/							5
-1-3																			0
-4-6				/		/	/			//									5
-7-9	/	/				/	/	//	/										7
-10-12				//	//		//												6
-13-15			/		//		/												4
-16-18			/	/	//	/	/												6
-19-21		/																	1
-22-24	/							/											2
-25-27																			0
-28-30			/																1
f	2	2	3	4	6	4	8	5	3	8	2	1	0	0	1	0	1	1	51

Hopkins Tests

The students to whom the Hopkins special tests were given were divided into age groups. Then for each age correlations were made between the score of each of the seven Hopkins tests and the percentage of trunk-length-weight deviation from the norm, using Dreyer's tables as a standard of reference. The tables below show the results.

In Number Test I the correlation for all ages is without significance. The highest plus one is +0.231 for the thirteen year old group and the highest minus one is -0.110 for the twelve year old group.

The same results obtain for all the other separate tests. In Symbol Test I the thirteen year old group had the highest plus correlation +0.115 and the twelve year old group the highest minus of -0.062.

In Memory Test I the highest plus correlation is that of the fourteen year group with +0.172 and the highest minus one is made by the fifteen year group -0.137.

In the Symbol Test II the only minus correlation is that of the twelve year olds -0.229, but all the plus correlations of the other age groups are insignificant.

In the Memory Test II the thirteen year group has the highest minus correlation -0.223. All others are too small to mean anything.

For the Omitted Letter Test no correlation is above -0.159 and +0.123.

In the Number Test II similar insignificant correlations

are shown for all age groups.

From these results one can not say that any one age group is more variable than another. All vary on the plus or minus side, but cluster near the zero point.

The results from the special tests are in accord with those of the group tests, and lead one to the conclusion that the physical and mental development are largely independent of each other. That is if by physical we mean the weight-height ratio when compared with accepted standards; and if we measure mental development by accepted "intelligence" and psychological tests.

There is also a gain in the Memory Test II over the score of Memory Test I, but no consistent gain from the younger to the old group. In this case the thirteen year and sixteen year groups made the greatest gain. That does not signify they have better memories for those two age groups had the lowest average scores on the first Memory Test, but it does mean they made greater improvement in the second over the first than the other age groups.

The table of averages does reveal the fact that with the passing of years more work can be accomplished within a certain time limit. In Number Test I there is a steady increase in the mean from age 12 to 16 and above. In the Symbol Test it is true except for the 13 year group who drop lower than the twelve year. In the Memory I test the 14 year old group is best, then comes the 12 year old, next the 15 year, followed by the 16 year old and the 13 year old group is

again lowest. In Symbol Test II there is the constant improvement except for a very slight drop in the 13 year group. In the Memory II Test the 15 year group has the lowest average and then the 14 year group next. There is such variation in the results of the two Memory tests that, from them, one can not say that at any given age memory is best. In both the Omitted Letter Test and Number Test II the constant improvement from year to year is shown.

One cannot say that the improvement is alone due to innate mental development or growth, as all the tests are learning tests and tests based upon learning.

When the scores of Number Test II were subtracted from Number Test I, we also find a steady minus increase which means that each older age group made a higher score on the second test than on the first one. Fatigue then lessens with increase in years.

Symbol Test II scores were also subtracted from those of Symbol Test I. Here we find the 12 year old group made a slightly greater score in the second over the first than any other age, although those of age groups 15 and 16 were approximately the same. But as all groups gained in the second test there was clearly no interference from the first test.

When the difference between Number Test II minus Number Test I was calculated to see the fatigue effects of one hour's constant work under pressure we find again insignificant correlations with the percentage trunk-length-

height ratio deviation showing that fatigue did not enter in.

The same was found to be the case when the scores of Symbol Test II were subtracted from Symbol Test I, and those of Memory Test II were subtracted from Memory Test I, in order to see if there had been any interference. The -0.343 of the 12 year group in the difference in memory scores means that there was a slight tendency for the heavy children to make greater improvement on the second over the first score.

TABLE of CORRELATIONS
with PERCENT-WEIGHT-TRUNK LENGTH

Tests	No. cases	12 years	No. cases	13 years	No. cases	14 years	No. cases	15 years	No. cases	16 years
1. Number I	33	-0.110	36	+0.231	67	+0.153	103	-0.036	148	-0.084
2. Symbol I	58	-0.063	50	+0.115	85	+0.113	125	+0.085	186	-0.058
3. Memory I	33	-0.127	36	+0.033	67	+0.172	103	-0.137	148	+0.074
4. Symbol II	33	-0.229	36	+0.073	67	+0.144	103	+0.098	148	+0.046
5. Memory II	33	+0.174	36	-0.223	67	+0.111	103	-0.083	148	+0.030
6. Omitted Letter	58	+0.123	50	+0.102	85	-0.076	125	+0.022	186	-0.159
7. Number II	33	-0.096	36	+0.113	67	+0.199	103	-0.075	148	-0.125
8. Difference Number I-II	33	+0.027	36	+0.006	67	-0.128	103	+0.141	148	+0.050
9. Difference Symbol I-II	33	-0.298	36	+0.244	67	-0.010	103	-0.019	148	-0.068
10. Difference Memory I-II	33	-0.343	36	+0.243	67	+0.055	103	-0.056	148	+0.021

TABLE of AVERAGES

Tests	No. cases	12 years	No. cases	13 years	No. cases	14 years	No. cases	15 years	No. cases	16 years & above
Number I	33	57.36	36	63.08	67	66.52	103	75.55	148	76.93
Symbol I	58	32.44	50	31.24	85	33.52	125	34.30	186	38.29
Memory I	33	49.45	36	41.25	67	50.58	103	48.67	148	43.69
Symbol II	33	34.36	36	34.16	67	36.49	103	37.51	148	40.29
Memory II	35	54.45	36	54.94	67	54.17	103	53.32	148	57.40
Omitted Letter	58	23.43	50	26.76	85	32.09	125	32.35	186	35.99
Number II	33	64.93	36	77.58	67	86.40	103	95.05	148	97.90
Difference Number I-II	33	-7.57	36	-14.5	67	-19.88	103	-18.10	148	-21.27
Difference Symbol I-II	33	-5.84	36	-4.50	67	-4.31	103	-5.51	148	-5.66
Difference Memory I-II	33	-5.00	36	13.97	67	-3.50	103	-3.20	148	-13.40
Percent-Weight Trunk Length	33	-9.90	36	-8.03	67	-7.52	103	-8.66	148	-4.34
Percent-Weight Trunk Length	58	-4.43	50	-5.30	85	-6.38	125	-7.37	186	-4.04

AGE GROUP 12

Test	No. Cases	Range	Average	S.D.	Coef. of Correl. with Percent Wt.-Trunk Length.
Number I	33	21-101	57.36	22.63	-0.110, P.E.±.115
Symbol I	58	7-71	32.44	10.52	-0.063, P.E.±.088
Memory I	33	5-72	49.45	17.60	-0.127, P.E.±.115
Symbol II	33	19-70	34.36	10.75	-0.229, P.E.±.111
Memory II	33	14-72	54.45	18.88	+0.174, P.E.±.113
Omitted Letter	58	0-45	23.43	8.08	+0.123, P.E.±.087
Number II	33	11-126	64.93	29.37	-0.096, P.E.±.116
Difference Number I-II	33	-37-+13	-7.57	12.60	+0.027, P.E.±.117
Symbol I-II	33	-27-+9	-5.84	7.61	-0.298, P.E.±.106
Memory I-II	33	-55-+45	-5.00	16.69	-0.343, P.E.±.114
% Weight-Trunk Length	33	-32-+29	-2.9	13.60	
% Weight-Trunk Length	58	-32-+39	-4.43	15.91	

AGE GROUP 13

Test	No. Cases	Range	Average	S.D.	Coef. of Correlation with % Wt-Tr. L.
Number I	36	15-123	63.08	27.44	+0.231, P.E. ±.106
Symbol I	50	10-49	31.24	8.29	+0.115, P.E. ±.093
Memory I	36	11-72	41.25	20.49	+0.033, P.E. ±.112
Symbol II	36	3-56	34.16	9.33	+0.073, P.E. ±.111
Memory II	36	15-72	54.94	19.26	-0.223, P.E. ±.106
Omitted Letter	50	11-50	26.76	8.76	+0.102, P.E. ±.094
Number II	36	20-181	77.58	38.72	+0.113, P.E. ±.110
Difference Number I-II	36	-58-+16	-14.5	15.34	+0.006, P.E. ±.112
Symbol I-II	36	-23-+19	-4.5	7.15	+0.244, P.E. ±.105
Memory I-II	36	-59-+39	-13.97	20.6	+0.243, P.E. ±.105
Percent Wt.-Trunk Length	36	-30-+53	-8.03	16.58	
Percent Wt.-Trunk Length	50	-30-+53	-5.3	15.99	

AGE 14

Tests	No. Cases	Range	Average	S.D.	Coef of Correl. with % Wt.-Trunk Length
Number I	67	20-120	66.52	22.42	+0.153, P.E.±.080
Symbol I	85	8-56	33.52	8.96	+0.113, P.E.±.072
Memory I	67	2-72	50.58	20.25	+0.172, P.E.±.079
Symbol II	67	23-54	36.49	6.97	+0.144, P.E.±.080
Memory II	67	0-72	54.17	22.15	+0.111,P.E. ±.081
Omitted Letter	85	12-61	32.09	9.56	-0.076, P.E.±.072
Number II	67	23-146	86.4	31.14	+0.199, P.E.±.079
Difference Number I-II	67	-85-+11	-19.88	16.52	-0.128, P.E.±.08
Symbol I-II	67	-19-+20	-4.31	6.64	-0.010, P.E.±.08
Memory I-II	67	-43-+52	-3.50	18.60	+0.055, P.E.±.08
Percent Wt.-Trunk Length	67	-28-+36	-7.52	13.24	
Percent Wt.-Trunk Length	85	-28-+37	-6.38	13.83	

AGE GROUP 15

Test	No. Cases	Range	Mean	Pass Score	S.D.	Coef. of Correl. with % Wt.-Trunk Length
Number I	103	0-190	75.55		27.80	-0.036 P.E.±.066
Symbol I	125	18-54	34.30	72	7.68	+0.085 P.E.±.060
Memory I	103	1-72	48.67	72	23.79	-0.137 P.E.±.065
Symbol II	103	0-58	37.51	72	8.25	+0.098 P.E.±.065
Memory II	103	0-70	53.32	72	23.19	-0.083 P.E.±.066
Omitted Letter	125	2-60	32.35		10.35	+0.022 P.E.±.060
Number II	103	0-161	95.05		33.10	-0.075 P.E.±.066
Difference Number I-II	103	-61-+59	-18.1		16.30	+0.141 P.E.±.065
Symbol I-II	103	-24-+36	-5.51		7.41	-0.019 P.E.±.066
Memory I-II	103	-65-+59	-3.20		24.85	-0.056 P.E.±.066
Percent Wt.-Trunk Length	103	-27-+22	-8.66		10.32	
Percent Wt.-Trunk Length	125	-27-+25	-7.37		11.07	

AGE GROUP 16

Test	No. Cases	Range	Mean	Pass Score	S.D.	Coef. of Correl. with % Wt.-Trunk Length
Number I	148	9-179	76.93		27.45	-0.084 P.E.±.055
Symbol I	186	0-65	38.29	72	10.17	-0.058 P.E.±.049
Memory I	148	0-72	43.69	72	22.29	+0.074 P.E.±.055
Symbol II	148	22-70	40.29	72	8.31	+0.046 P.E.±.055
Memory II	148	0-72	57.40	72	19.71	+0.030 P.E.±.055
Omitted Letter	186	9-62	35.99		8.97	-0.159 P.E.±.048
Number II	148	0-219	97.90		34.00	-0.125 P.E.±.054
Difference Number I-II	148	-56 -+16	-21.27		10.41	+0.050 P.E.±.055
Symbol I-II	148	-32-+34	-5.66		8.16	-0.068 P.E.±.055
Memory I-II	148	-62-+51	-13.40		21.75	+0.021 P.E.±.055
Percent Wt.-Trunk Length	148	-28-+36	-4.34		13.11	
Percent Wt.-Trunk Length	148	-28-+36	-4.04		13.05	

Correlation: Number Test I and Percent. Weight-Trunk Length

of 103 Students - 15 years of age.

r = -0.036, P.E. ± .066

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
190 - 194									1									1
185 - 189																		0
180 - 184																		0
175 - 179																		0
170 - 174																		0
165 - 169																		0
160 - 164																		0
155 - 159																		0
150 - 154																		0
145 - 149																		0
140 - 144																		0
135 - 139																		0
130 - 134																		0
125 - 129						1												1
120 - 124																		0
115 - 119	1		1							1		11						5
110 - 114				1	1		1			1								4
105 - 109							11	1										3
100 - 104					11	1			1									4
95 - 99		111		1			1	1										6
90 - 94				1	1111			11									1	8
85 - 89						1	1	11	1									5
80 - 84	1	1	1	11	1	1	1	11										10
75 - 79				1		1	1	11	1	1	1		1					9
70 - 74			11					1										3
65 - 69			1		1	11	1				1				1			7
60 - 64	1		1	1			1	1					1					6
55 - 59		11			1					1	1							5
50 - 54	1		1	1			11	111		11			11	1				13
45 - 49		11										1						3
40 - 44				1				1										2
35 - 39														1				1
30 - 34							1	1		1								3
25 - 29			1			1												2
20 - 24																		0
15 - 19																		0
10 - 14																		0
5 - 9																		0
0 - 4						1	1											2
	4	6	8	7	10	9	13	17	4	7	3	3	4	2	1	0	1	103

Correlation: Symbol Test I and Percent Weight-Trunk Length

of 125 Students - 15 years of age

r = +0.085, P.E ± .060

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	+26 - 24	
54 - 56													I						1
51 - 53																			0
48 - 50					I			I			I						I		4
45 - 47					II	I			I	I									5
42 - 44	I	I	I			II	III		II	III				I					14
39 - 41	II		I	II	II	I	II				I		I	I				I	14
36 - 38	I	I	III		II	III	II	IIII	I		I	I	I						20
33 - 35	I	I		II	II	I	II	I	II	I	I	I	I						16
30 - 32		II	I	III		I		𝍸		IIII			I	I	I				19
27 - 29			I		I	I	I	I			II					I			8
24 - 26		III	I	II			II	III											11
21 - 23			I		I		III	II				I			I				9
18 - 20					I		I	II											4
	5	6	9	9	12	10	16	19	6	9	6	3	5	3	2	1	1	1	125

Correlation: Memory Test I and Percent Weight-Trunk Length of 103 Students - 15 years of age.

r = -0.137, PE ± .065

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
72 - 74	I	I	III	IIII	IIII		IIII	~~IIII~~	I	I	II		I					27
69 - 71				I	I	IIII	I						I	I				9
66 - 68					I			I										2
63 - 65		II		I				I			I							5
60 - 62	I					I	I	II	I			II						8
57 - 59		I				I	I											3
54 - 56										I								1
51 - 53																		0
48 - 50			I					I										2
45 - 47	I	II					I											4
42 - 44						I		I						I				3
39 - 41	I		I															2
36 - 38				I		I		I										3
33 - 35				I				I										2
30 - 32		II	I			I	I		I	I					I			8
27 - 29					I													1
24 - 26			I										I					2
21 - 23					I													1
18 - 20										I							I	2
15 - 17					I		I	I	I			I	I					6
12 - 14			I				I											2
9 - 11							I	II		I								4
6 - 8				I			I											2
3 - 5										I								1
0 - 2					I			I		I								3
	4	8	8	9	10	9	13	17	4	7	3	3	4	2	1	0	1	103

Correlation: Symbol Test II and Percent Weight-Trunk Length of 103 Students 15 years of age.

r = +0.098, P.E. ±.065

1

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
57 - 59												I						1
54 - 56								I		I							I	3
51 - 53						II	I											3
48 - 50	I			I			I	I	I					I				6
45 - 47					I					I								2
42 - 44			I	III	I	II				I	I		I	I				11
39 - 41	III	III	III	I	IIII	II		I	I	I	II		II					23
36 - 38		II		I	I	I	II	III	I	I			I					13
33 - 35		I	II	I	I	I	II	II	I	I		I			I			14
30 - 32		II	I	I	I	I	III	IIII										13
27 - 29			I	I			III	III										8
24 - 26					I		I			I		I						4
21 - 23								I										1
18 - 20																		0
15 - 17																		0
12 - 14																		0
9 - 11																		0
6 - 8																		0
3 - 5																		0
0 - 2								I										1
	4	8	6	9	10	9	13	17	4	7	3	3	4	2	1	0	1	103

Correlation: Memory Test II and Percent: Weight-Trunk Length.

of 103 Students - 15 years of age.

r = -0.083. PE ±.066

	-25 - 27	-22 - 24	-14 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
72 - 74	II	IIII	IIII	IIII	IIII	II	II	卌 I	II	II	II	I	IIII					39
69 - 71				I		II	I	II		I		I						8
66 - 68			I			I		I										3
63 - 65		I			I		I	I										4
60 - 62						I	II		I	I								5
57 - 59								I						I				2
54 - 56		I	I															2
51 - 53																		0
48 - 50	I			I	I		III											6
45 - 47			I		II													3
42 - 44		I															I	2
39 - 41							I				I							2
36 - 38																		0
33 - 35						I	I	I		I								4
30 - 32				I		I												2
27 - 29								II										2
24 - 26	I					I												2
21 - 23									I									1
18 - 20				I				I		I								3
15 - 17								I										1
12 - 14				I			I					I						3
9 - 11			I		II									I				4
6 - 8		I								I								2
3 - 5							I											1
0 - 2								I							I			2
	4	8	8	9	10	9	13	17	4	7	3	3	4	2	1	0	1	103

Correlation: Omitted Letter Test and Percent. Weight-Trunk Length of 125 Students 15 years of age.

r = +0.022. P.E ± .060

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	+26 - 24	
60 - 62													I						1
57 - 59					I														1
54 - 56																			0
51 - 53									I			I							2
48 - 50	I	I					I	I											4
45 - 47					I	I		II	I		I							I	7
42 - 44		I	I	I	I	I	I	I		I									8
39 - 41	I			I	I		II	I		II									8
36 - 38	I	I	II	II	I	IIII	I	I	III	I	I	I	I						20
33 - 35		I	II		II	I	I				I			II	II				12
30 - 32	I		I		I	I	I	I		I	I		I						9
27 - 29		II	II		I		II	𝍸 I		II			II	I					18
24 - 26		I	I	IIII		I	II	II	I	I	I					I	I		16
21 - 23	I			I	I			II		I									6
18 - 20		I					II												3
15 - 17						I	I	II			I								5
12 - 14							I					I							2
9 - 11																			0
6 - 8					I														1
3 - 5					I														1
0 - 2							I												1
	5	6	9	9	12	10	16	19	6	9	6	3	5	3	2	1	1	1	125

Correlation: Number Test II and Percent. Weight-Trunk Length

of 103 Students 15 years of age.

r = -0.075, P.E. ± .066

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
160 - 164							I											1
155 - 159																		0
150 - 154			I				I											2
145 - 149										I								1
140 - 144	I			II			I	I										5
135 - 139		II			I													3
130 - 134					I	II			I			I						5
125 - 129					I			I		II								4
120 - 124					I			II										3
115 - 119						I		I					I					3
110 - 114		I	I	I	I		II	I										7
105 - 109	I	I			I	II		I	I			I						8
100 - 104				II	II		I	I	I		I		I				I	10
95 - 99					I		I	I	I									4
90 - 94	I		I										I					3
85 - 89			II	I	I			II										6
80 - 84							II						I					3
75 - 79				I		I	I	II										5
70 - 74				I		I	I	I		I					I			6
65 - 69			I															1
60 - 64	I	I	I					II		II	II							9
55 - 59		I										I						2
50 - 54		I								I								2
45 - 49		I																1
40 - 44														II				2
35 - 39			I	I				I										3
30 - 34																		0
25 - 29						I	I											2
20 - 24																		0
15 - 19						I												1
10 - 14																		0
5 - 9																		0
0 - 4							I											1
	4	8	6	9	10	9	13	17	7	7	3	3	4	2	1	0	1	103

Correlation: Difference between Number Tests I and II and

Percent Weight - Trunk Length of 130 students

15 years of age.

r = +0.141, P.E. ± .065

	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
+55 - 59									I									1
+50 - 54																		0
+45 - 49																		0
+40 - 44																		0
+35 - 39																		0
+30 - 34																		0
+25 - 29																		0
+20 - 24																		0
+15 - 19																		0
+10 - 14							I							I				2
+5 - 9				I								I						2
0 - +4		II	I	I			II	IIII			I							11
-5 - -1		I				II		I										4
-10 - 6	II					II			I	I	I	I		I	I			10
-15 - 11		II	II	I	II	I			I	I		I	I				I	13
-20 - 16			II	III	III	I	III	III	I	III								19
-25 - 21		I			I		I	I			I		I					6
-30 - 26	I		II	II	II	I	II	I		I			I					13
-35 - 31			I		I	I		~~IIII~~ II					I					11
-40 - 36		I				I	II											4
-45 - 41	I	I					I											3
-50 - 46				I			I			I								3
-55 - 51																		0
-60 - 56																		0
-65 - 61					I													1
	4	8	8	9	10	9	13	17	4	7	3	3	4	2	1	0	1	103

Correlation: Difference between Symbol Tests I and II
with Percent. Weight-Trunk-Length
of 103 Students -15 years of age.

r = -0.019, P.E. ± .066

Difference	-25 – 27	-22 – 24	-19 – 21	-16 – 18	-13 – 15	10 – 12	-7 – 9	-4 – 6	-1 – 3	+2 – 0	+5 – 3	+8 – 6	+11 – 9	+14 – 12	+17 – 15	+20 – 18	+23 – 21	
+38 – 36								I										1
+35 – 33																		0
+32 – 30																		0
+29 – 27																		0
+26 – 24																		0
+23 – 21																		0
+20 – 18																		0
+17 – 15																		0
+14 – 12									I									1
+11 – 9													I					1
+8 – 6		I								I								2
+5 – 3			I		I	I	II	III				I						9
+2 – 0		I	I	II	II		I						I					8
-1 – 3	I	II	II	I	II	IIII	I	III	I	II			I					20
-4 – 6	II	I	II		II	II	IIII	IIII	I	I	I	I						21
-7 – 9	I	I	I	IIII	I		IIII	III	I	I	I			I			I	20
-10 – 12		I	I	I	I		I			II	I		I	I	I			11
-13 – 15						I		I										2
-16 – 18		I		I	I	I		II										6
-19 – 21																		0
-22 – 24												I						1
	4	8	8	9	10	9	13	17	4	7	3	3	4	2	1	0	1	103

Correlation: Difference between Memory Tests I and II and Percent Weight-Trunk Length of 103 Students 15 years of age.

$r = -0.056$, P.E. ± .066

Difference	-25 - 27	-22 - 24	-19 - 21	-16 - 18	-13 - 15	-10 - 12	-7 - 9	-4 - 6	-1 - 3	+2 - 0	+5 - 3	+8 - 6	+11 - 9	+14 - 12	+17 - 15	+20 - 18	+23 - 21	
+55 - 59				I			I											2
+50 - 54																		0
+45 - 49																		0
+40 - 44		I					I	II										4
+35 - 39								I						I				2
+30 - 34						II									I			3
+25 - 29							I											1
+20 - 24											I							1
+15 - 19				II	I		I	I										5
+10 - 14	II						I	I						I				5
+5 - 9			I		II	I			I									5
0 - +4	I	II	III	IIII	III	II	III	III	I	I	II	I	I					27
-5 - 1				I	I	I		I		I			I					6
-10 - 6		II			I	I		II		I								7
-15 - 11		II	I					I	I			II						7
-20 - 16					I	I				I								3
-25 - 21			II		I			I									I	5
-30 - 26	I							I		II								4
-35 - 31							II											2
-40 - 36		I				I	II	I										5
-45 - 41			I						I									2
-50 - 46													I					1
-55 - 51							I	II		I								4
-60 - 56													I					1
-65 - 61				I														1
	4	8	8	9	10	9	13	17	4	7	3	3	4	2	1	0	1	103

NUMBER TEST I

Age	No. cases	Range	Average	S.D.	Coef. of Correlation with Percent Wt.-Trunk Length
12	33	21-101	57.36	22.63	-0.110, P.E. ±.115
13	36	15-123	63.08	27.44	+0.231, P.E. ±.106
14	67	20-120	66.52	22.42	+0.153, P.E. ±.080
15	103	0-190	75.55	27.80	-0.036, P.E. ±.115
16 & above	148	9-179	76.95	27.45	-0.084, P.E. ±.055

NUMBER TEST II

Age	No. Cases	Range	Average	S.D.	Coef. of Correlation with Percent Wt.-Trunk Length
12	33	11-126	64.93	29.37	-0.096, P.E. ±.116
13	36	20-181	77.58	38.72	+0.113, P.E. ±.110
14	67	23-146	86.4	31.14	+0.199, P.E. ±.079
15	103	0-161	95.05	33.10	-0.075, P.E. ±.066
16 &	148	0-219	97.90	34.00	-0.125, P.E. ±.054

SYMBOL I

Age	No. Cases	Range	Average	Pass Score	S.D.	Coef. of Correlation with Percent Weight-Trunk Length.
12	58	7-71	32.44	72	10.52	-0.063 P.E. ±.088
13	50	10-49	31.24	72	8.29	+0.115, P.E. ±.093
14	85	8-56	33.52	72	8.96	+0.113, P.E. ±.072
15	125	18-54	34.30	72	7.68	+0.085, P.E. ±.060
16& above	186	0-65	38.29	72	10.17	-0.058, P.E. ±.049

SYMBOL II

Age	No. Cases	Range	Average	Pass Score	S.D.	Coef. of Correlation with Percent Weight-Trunk Length
12	33	19-70	34.36	72	10.75	-0.229, P.E. ±.111
13	36	3-56	34.16	72	9.33	+0.073, P.E. ±.111
14	67	23-54	36.49	72	6.97	+0.144, P.E. ±.080
15	103	0-58	37.51	72	8.25	+0.098, P.E. ±.065
16& above	148	22-70	40.29	72	8.31	+0.046, P.E. ±.055

MEMORY TEST I

Age	No. Cases	Range	Average	Pass Score	S. D.	Coef. of Correlation with Percent Weight-Trunk Length
12	33	5-72	49.45	72	17.60	-0.127, P.E.±.115
13	36	11-72	41.25	72	20.48	+0.033, P.E.±.112
14	67	2-72	50.58	72	20.25	+0.172, P.E.±.079
15	103	1-72	48.67	72	23.79	-0.137, P.E.±.065
16	148	0-72	43.69	72	22.29	+0.074, P.E. .055

MEMORY TEST II

Age	No. Cases	Range	Average	Pass Score	S. D.	Coef. of Correlation with Percent Weight-Trunk Length
12	33	14-72	54.45	72	18.88	+0.174, P.E. ± .113
13	36	15-72	54.94	72	19.26	-0.223, P.E. ±.106
14	67	0-72	54.17	72	22.15	+0.111, P.E. ±.081
15	103	0-70	53.32	72	23.19	-0.083, P.E. ±.066
16& above	148	0-72	57.40	72	19.71	+0.030, P.E. ±.055

OMITTED LETTER

Age	No. Cases	Range	Average	S.D.	Coef. of Correlation with Percent Weight-Trunk Length
12	58	0-45	23.43	8.08	+.123 P.E. ±.087
13	50	11-50	26.76	8.76	+0102, P.E. ±.094
14	85	12-61	32.09	9.56	-0.076, P.E. ±.072
15	125	2-60	32.35	10.35	+0.022, P.E. ±.060
16& above	186	9-62	35.99	8.97	-0.159, P.E. ±.048

DIFFERENCE NUMBER TESTS I-II

Age	No. Cases	Range	Average	S.D.	Coef. of correlation with Percent Weight-Trunk Length
12	33	-37-+13	-7.57	12.60	+0.027, P.E.. ±.117
13	36	-58-+16	-14.5	15.34	+0.006, P.E. ±.112
14	67	-85-+11	-19.88	16.52	-0.128, P.E. ±.080
15	103	-61-+59	-18.10	16.30	+0.141, P.E. ±.065
16	148	-56-+16	-21.27	10.41	+0.050, P.E. ±.055

DIFFERENCE SYMBOL TEST I-II

Age	No. Cases	Range	Average	S.D.	Coef. of Correlation with Percnet Weight-Trunk Length
12	33	-27-+9	-5.84	7.61	-0.298, P.E. ±.106
13	36	-23-+19	-4.5	7.15	+0.244, P.E. ±.105
14	67	-19-+20	-4.31	6.64	-0.010, P.E. ±.080
15	103	-24-+36	-5.51	7.41	-0.019, P.E. ±.066
16& above	148	-32-+36	-5.66	8.16	-0.068, P.E. ±.055

DIFFERENCE MEMORY TEST I-II

Age	No. Cases	Range	Average	S.D.	Coef. of Correlation with Percent Weight-Trunk Length
12	33	-55-+45	-5.00	16.09	-0.43, P.E. ±.114
13	36	-59-+39	-13.97	20.60	+0.243, P.E.±.105
14	67	-43-+52	-3.50	18.60	+0.055, P.E.±.080
15	103	-65-+59	-3.20	14.91	-0.056, P.E.±.066
16& above	148	-62-+51	-13.40	21.75	+0.021, P.E.±.055

The table below shows the average difference when the scores of Number Test II are subtracted from the scores of Number Test I for the three "nutritional" sections, underweight, normal and overweight, of each age group.

DIFFERENCE BETWEEN NUMBER TESTS I-II

Ages	No. Cases	10% & below	Cases	-9% to 20%	Cases	20% & above	Casess
12	33	-5.35	20	-12.54	11	-2.5	2
13	36	-12.21	19	-19.80	15	+3.5	2
14	67	-18.3	35	-19.2	28	-29.7	4
15	103	-19.2	48	-16.7	54	-13.0	1
16	148	-22.6	60	-20.0	78	-21.5	10

All groups at all ages make a gain in the second test except the "overweight" 13 year old group. At the ages 12 and 13 it is the "normal" group that shows the greatest gain. In year 14 the "overweight" group make the greatest gain on an average. However, in years 15 and 16 it is the "underweight" group that makes the greatest gain. The results here are so diverse, one cannot say that any one "nutritional group is consistently better than another. The number of cases in the "overweight" group are entirely too few to carry much significance with their results, however, it is in one year only (14) that they excell the other two groups. On the other hand the "underweight" excells twice, while the "normal" shares honors, also leading twice.

So far as the fatigue element is concerned it is shown

only once and that is with the 13 year "overweight" group. They have an average of +3.5, which means that they made slightly better scores on the first number test than on the second, and laziness may explain that. All the other "nutritional" groups at all ages have a minus sign which means that they made higher scores on the second test than they did on the first, and therefore show no fatigue signs.

DIFFERENCE BETWEEN MEMORY TEST I-II

Ages	No. Cases	10% and Below	-9% to +20%	20% and Above
12	33	-4.20	-3.00	-24.00
13	36	-14.31	-17.26	+14.00
14	67	-2.90	-4.70	-1.25
15	103	-2.50	-3.80	-23.00
16	148	-14.30	-12.50	-17.30

With these tests again it is the "overweight" group of 13 which alone does not make an improvement in the second score over the first. With the 12, 15, and 16 year groups it is the "overweight" group which makes the greatest gain, thereby showing the least interference, but at 13 and 14, it is the "normal" group that are least affected.

DIFFERENCE BETWEEN SYMBOL TEST I-II

Age	No. Cases	10% and Below	-9% to + 20%	20% and Above
12	33	-5.80	-4.63	-13.00
13	36	-5.31	-4.66	+4.50
14	67	-4.90	-3.4	-4.70
15	103	-4.80	-4.00	-8.00
16	148	-4.25	-4.00	-8.60

Here, once more, it is the "overweight" 13 year group which is the only one failing to improve on the second test over the first. And it is the "overweight" group which makes greatest gains in the 12, 15 and 16 groups, as was the case with the Memory Tests. At 13 and 14 it is the "underweight" groups which make the largest gains.

In general one would conclude the normal or below normal weight groups are not lacking in concentration and attention, to the extent of showing any interference.

PUBLIC SCHOOL PUPILS & COLLEGE STUDENTS

TABLE OF PERCENTAGES (DREYER'S TABLES)

	No. of	Underweight		"Normal"		Overweight	
Ages	Cases	Below 10%	Cases	-9% to +20%	Cases	20% and Above	Cases
12	33	60.6	20	33.3	11	6.	2
13	36	52.77	19	41.66	15	5.55	2
14	67	52.23	35	41.79	28	5.97	4
15	103	46.6	48	52.42	54	0.97	1
16	148	40.54	54	52.7	78	6.75	10
Av. total	387	50.54	182	44.37	186	5.04	19

The table above shows that as age increases there are fewer "underweight"" and that there is a tending to go over into the "normal" group. The percentage in the "overweight" group is fairly constant except in year fifteen, where there is only approximately one percnet. The great number of "underweight" however is worthy of note, it being ten times that of the "overweight". It also happens that the medical investigators have mentioned that there are ten times as many underweight as overweight, but their percentages were not the same as the above; they say 20% are underweight for their height, while only 2 % are overweight. We get the same proportion but the percentage being so much larger at either end of the scale reduces materially the size of the normal group. To be sure, they were probably discussing results obtained by the use of tables such as Wood's which consider the full stature, whereas here reference is to the Dreyer Tables.

SUMMARY

All correlations between height-weight (standing or sitting) ratios when referred to Wood's or Dreyer's standards and group intelligence scores or I.Q. derived therefrom are so low they are without significance.

When the percentage deviations derived from Dreyer's Tables are correlated with the special Hopkins Tests the coefficients are likewise too low to show any relationship between the two arrays.

The fatigue element showed only in the case of the "overweight" group at thirteen, but as there were only two cases it has little importance.

Interference likewise showed only with the same two cases. But at that is is not the "underweight" group which suffered either from fatigue or interference.

The adolescents of this study exceed in height and weight age for age the norms of Clark, Sydenstricker and Collins derived from measures on public school children in the same and adjoining states. Both groups were of "pure American Stock". Those of this study were all born in the United States, most of them in the locality in which the measurements were made; and only two parents of foreign birth were reported, one Irish and one German father, so even there stock would be practically the same.

One is forced to conclude therefore that there is no relation between the physical development measured by the height-weight ratio of certain accepted standards and mental

development, also measured by certain accepted standards, whether they be group or special psychological tests.

This does not dispose,however,of the possibility of a relationship between physical and mental development. The height-weight index may not be an accurate measure of physical development,or the tests may not measure mental development. In the case of mental measurement ,however,there are objective criteria by which to guage the extent to which they achieve their purpose,while as yet,there are no such definite criteria for the physical measurements. One is tempted ,therefore to question the validity of the height-weight index as an adequate mesure of physical fitness,or at least,of the kind of physical fitness which is demanded in the performance of mental tests.

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